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ЯЗЫК И МИРОВАЯ КУЛЬТУРА: ВЗГЛЯД МОЛОДЫХ ИССЛЕДОВАТЕЛЕЙ

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К41 **ЯЗЫК И МИРОВАЯ КУЛЬТУРА: ВЗГЛЯД МОЛОДЫХ ИССЛЕДОВАТЕЛЕЙ**: сборник материалов XIV Всероссийской научно-практической конференции / под ред. Н.А. Качалова. Томский политехнический университет. – Часть II. – Томск: Изд-во Томского политехнического университета, 2014. – 211 с.

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Сборник предназначен для преподавателей, аспирантов и студентов.

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Prospects of nuclear energy research and analysis of the position of people on this issue

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Joining the 21st century and the rapid development of electric technology, humanity is faced with a large demand for electricity. All activity of modern man associated with the use of electrical energy. And this so-called "addiction" makes us more hostages electricity. Therefore, in the new century, a huge amount of resources, both material and mental spent on inventing new ways to produce energy, which is so necessary to people.

It is the use of solar energy through solar panels that have worked well in many countries, but they have several significant drawbacks : first, these batteries are expensive, and secondly, they are unlikely to be able to fill the power consumption with a small coefficient of efficiency, in places with shortage of sunlight. There are a number of alternative methods of energy that I want to tell you.

1) It is the use of solar energy through solar panels that have worked well in many countries, but they have several significant drawbacks: first, these batteries are expensive, and secondly, they are unlikely to be able to fill the power consumption with a small coefficient of efficiency, in places with shortage of sunlight.

2) One of the most promising sources of energy is wind. Principle of operation of wind turbines elementary. Wind force used to drive the wind wheel. This rotation in turn passed the rotor of the electric generator. Advantage of the wind generator is primarily the fact that the wind field, the wind can be regarded as an inexhaustible source of energy. In addition, wind turbines, producing energy, do not pollute the atmosphere with harmful emissions. Inconstancy of the wind and quite a large number of generated energy makes this species is not decisive.

3) A huge amount of thermal energy stored in the depths of the Earth. Geothermal energy and these suggest using as an alternative source of geothermal energy supporters. However, this view is still quite difficult to use.

In my opinion, the most promising direction of development of the electricity is nuclear power, at the moment only nuclear power in the future will be able to save the world from the energy crisis.

« Since then, as the phenomenon of radioactivity was discovered, it has been more than a century (as happened receiving coverage in 1896). Until a few decades it took a rocket scientist to grasp all the intricacies of the essence of this phenomenon and learn to use it for practical purposes..» [1. С. 3.].

Discovery of radioactive decay and the use of nuclear power to solve the problem of energy shortages. However, there was a problem of confidence in the atom.

« It is human nature to be afraid of what he has no idea. We are afraid of radiation and that is connected with it, because little is known about her. However, that radiation is an indispensable tool for the detection and successful treatment of deadly diseases; nuclear energy generated in nuclear power plants – is light heat is working in our homes televisions, computers, household appliances.

All living organisms are continually experiencing the effect of natural ionizing radiation. There is even a theory that the origin of life on Earth has been associated with exposure to strong radiation fields . Our existence seems to have unthinkable without the use of knowledge about the atomic energy : almost all advanced countries actively develop nuclear power, jointly build the first fusion power reactor ; and the extent of use of radiation and

radioactive isotopes in space engineering, medicine, biology, food industry, agriculture, geology is increasing every year .» [1. C. 4.].

Distrust of nuclear energy due to several objective reasons. First, people are afraid to use peaceful nuclear energy for military purposes, it's stereotypes of the Cold War. Second, it's a major accident at Chernobyl (USSR) and Fukushima (Japan).

Third (after danger reactors and waste problems) main the danger of nuclear power is its close connection with atomic weapons.

«"Nuclear power – it's the atomic bomb, giving electricity" – figuratively, but physically accurate, said Nobel laureate physicist P. Kapitsa.» [2. C. 59.].

«The tragedy for the whole world that the establishment of nuclear power plants in a country today predetermines the possibility of creating in this country of nuclear weapons.» [2. C. 62.].

26 April 1986 at the Chernobyl nuclear power plant was the largest in the history of the world nuclear power accident. The accident resulted in radioactive contamination with cesium-137 levels above 1 Ci/km2 (37 kBq/m^2) underwent in 17 countries in Europe with total area of 207,500 square kilometers. Significantly contaminated with cesium- 137 were the territory of Ukraine (37,630 square kilometers), Belarus (43,500 square kilometers), the European part of Russia (59,300 square kilometers).

«In 2011, the 25th anniversary of the explosion of the fourth unit of the Chernobyl nuclear power plant. Consequences of this biggest industrial disaster in the history of mankind devoted many thousands of scientific papers, and effects of the overall picture begins to clear shape . This picture is very different from the one from the first days after the Holocaust drew (and still draws) supporters of nuclear energy development . I recall that a few months after the Holocaust, the then head of the IAEA G. Blix curled in an interview that nuclear power can withstand a Chernobyl type accident every year.» [2. C. 162.].

The Chernobyl accident has generated fear and distrust of the peaceful atom world for many years. This accident has generated fear and distrust of the peaceful atom in the world for many years. All newspapers were full of protests against nuclear power. People have become more cautious about the atom, received an important lesson.

March 11, 2011 as a result of the strongest in the history of the Japan earthquake and ensuing tsunami there was a major radiation accident at the nuclear power plant Fukushima-1. As a result of all these incidents at the plant "Fukushima-1" radiation leak occurred, both by air and on the water, so the government had to evacuate people from the area of a radius of 20 km from the station. In addition, the exclusion zone was forbidden to be people, and people living within 30 km from the station.

After the accident, the whole world was scared again, but to a lesser extent. People took it more adequately.

However, relying on the atom, do not forget about safety.

The design, construction, operation and decommissioning of nuclear power plants, safety issues are a priority. To do this, at the stations used the latest equipment and advanced security systems

Nuclear power plant safety is now a priority. Place the plant construction to be safe, in the sense seh. The most earthquake-resistant areas should be a place of construction. Eliminating a number of dangers, it is an earthquake, tsunami, etc.

The most advanced equipment, the best specialists and responsible attitude to their office workers do our best station in the world. Perhaps this is the lesson of Chernobyl is left its mark on the direction of development of nuclear power in our country.

Due to the high demand for electricity, it is necessary to use nuclear energy. For several reasons, nuclear power plants are more environmentally friendly, more productive and until what other energy sources can not solve the problem of lack of energy. Therefore, the future of nuclear power, and do not be afraid to use it!.

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The basic voltage and reactive power control devices

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The target of this paper is to present the main devices of automatic voltage regulation in the power system. The basic function and principles of operation of these devices are described in this paper.

To ensure a reliable supply of energy imposes mandatory requirement to maintain a certain level of voltage. The voltage level is closely related to the reactive power. Increasing or decreasing the voltage level occurs due to increase or decrease of the amount of reactive power into the grid. Therefore, the control of voltage and reactive power is one of major issues in the power system operation. After that, basic units of voltage regulation and reactive power in the network are considered.

Automatic voltage regulator of synchronous generators (AVR).

The automatic voltage control of synchronous generators occupies an important place among numerous automatic control systems for energy systems. Originally, the sole task of AVR was to maintain a constant voltage on the terminals of generators, but the development of electric power systems expanded the task list relating to AVR.

Automatic adjustment is based on three principles:

- perturbing effects;
- controlled deviation;
- combination of the above principles.

The simplest AVR performing voltage regulation of generations is a compounding device by full load current. It is also least accurate, so it is usually connected to the controller of voltage deviation, which should provide sufficient accuracy voltage regulation of generator, thereby yielding a device with a combined principle of regulation.

Phase compounding devices are more accurate, but they are hardly ever used without a voltage regulator. Increase of the unit capacity of synchronous generators and emergence of high-frequency excitation systems have promoted the development of AVR of proportional action. This type of device provides voltage regulation in the full range of possible changes in its normal operating condition, as well as the force driving in emergency mode.

However, the advent of AVR proportional action has not stopped development of systems of automatic voltage regulator. Energy systems grow, length of transmission lines increases as a result requirements of AVR are increased so automatic excitation regulator of

strong action was developed. These regulators use the principle of regulation by the deviation and have a high speed and rather complex control algorithm.

Nowadays, there are many variations of functional structure of automatic excitation regulator (AER) of strong action, but all of them can lead to a common one, consisting of three parts: a sensor arrangement, logical (computer) and the executive.

Sensor arrangement part of the regulator contains three main discriminating elements: voltage, frequency and excitation current, and two additional ones: discriminating element of reactive and active currents. So as regulatory impact may be built by:

- voltage deviation from the target value;
- the first derivative of the voltage;
- the first and second derivatives of the current power line;
- change and the first derivative of the frequency.

Discriminating elements produce signals to reject their control parameters and transmit them directly to the adder and logic part that coordinates signals derived from mode parameters. The adder receives signals from discriminating elements, the logical part and the element of settings change, after that the adder generates a regulating effect to the digital pulse position actuator control, which in turn generates pulse currents of thyristors. Fundamentally, the same algorithm is used in microprocessor controllers; their feature is the computing part, which consists of two microprocessors.

The main functions performed by modern AER include:

- automatic control of excitation current;
- forced excitation relay;
- current limitation of the rotor at boosting of the double level;
- automatic unloading generators overcurrent rotor and stator reactive current;
- change in the target voltage during synchronization of generators;
- limitation of excitation reduction at the consumption of reactive power;
- adjustment of reactive power generators operating in parallel (group controlled excitation);
- regulation on the deflection of the rotor current in the run- turbine generators of a nuclear power plant (NPP);
- generator protection overvoltage in case of load shedding.

Tap change under load device (TCUL) and STATCOM.

For distribution networks mainly optimal mode of voltage and reactive power is determined by ensuring the required quality of electricity delivered to consumers with minimum losses and stability of asynchronous load. For distribution networks voltage regulation is possible only if there is sufficient provision of reactive power load in the corresponding node. For voltage regulation it is expedient to use a regulating and compensating device. Currently, the most common among them are transformers with a Tap change under load (TCUL), and static and synchronous compensators. The transformer itself is not a source of reactive power. Voltage regulation of transformers with tap-changer is due to changes in the transformation ratio of the transformer, causing a change of reactive power flow through the transformer. Therefore, regulating the voltage by such transformers is effective only if there is a local source of reactive power.

Classic adjustable reactive power source is synchronous compensator. The disadvantages of these machines include the relatively high cost and limited range regulation of reactive power consumption mode. However, restrictions on their adjustment range were minimized

by developing automatic control of synchronous compensators and designing compensator with two excitation windings.

Alternative to the synchronous compensator is static thyristor compensators (STC). Creation of them is result of development of semiconductor technology. Advances in power electronics led to the possibility of creating a new type compensator called STATCOM.

The STATCOM uses algorithms relating to vector control of voltage converter. In general vector control involves measurement of the instantaneous values of voltage and current three-phase system, converting them into orthogonal components of selected system axes d and q, the computation of control actions required in this coordinate system and then transforming them into three-phase system to be implemented in the form of control signals applied to the control object.

Reactive power control system of STATCOM is performed by generating an ideal voltage by the converter. The current in the inductive reactance lags in phase by an angle $\pi/2$ from the voltage across the defined difference of network voltage Uc and converter Un. If these voltages are in phase Uc > Un current will be inductive and STATCOM system consumes reactive power from the network. When Uc < Un there is the capacitive current that contributes to the generation of reactive power. Thus, the STATCOM controls reactive power by varying the voltage at the output of the converter Un.

Similarly, for the active power control by the STATCOM it is necessary to change the phase of the voltage Un relative to the network voltage Uc.

The paper presents only basic voltage control devices. In general voltage and reactive power regulation is an intensive process demanding the use of innovation technologies and profound knowledge of electrical engineering.

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Energetics: energy modernization and clean energy

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Introduction

Energetics Incorporated, a wholly owned subsidiary of VSE Corporation, is a full-service technical and management consulting company serving public- and private-sector clients. Also it is a firm helping clients solve today's complex global challenges: energy modernization, energy efficiency, clean energy and climate changes. Energetics is headquartered in Columbia, Maryland, USA with offices in Washington, DC and Arlington, Virginia.

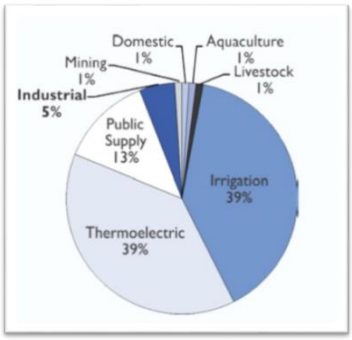
The history of the company.

Energetics was founded in 1979 by a small group of engineers in Columbia, Maryland. They named the company "energetics", because it is a branch of mechanics that deals with energy and its transformations. In 1995, Energetics was acquired by VSE Corporation,

which provided the company with a new opportunity for growth. For the past 30 years, Energetics has enjoyed steady growth. What began with a few employees in a small office has grown into a successful company with over 160 employees located among six main offices across all the USA.

Company activities

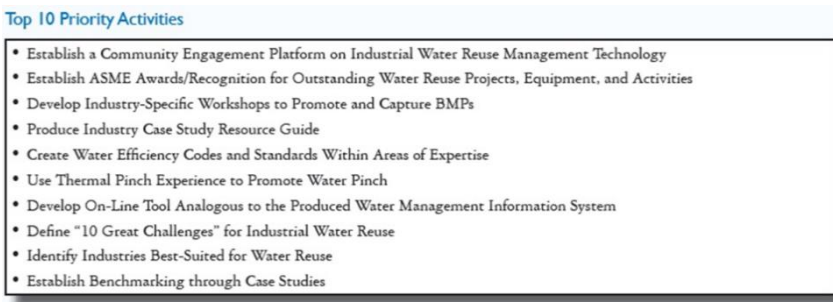
For 30 years, Energetics Incorporated has helped their clients develop and manage effective research and information programs in the fields of energy, manufacturing, climate and environment. Their success lies in their ability to align program capabilities with critical national objectives and to effectively communicate complex issues to enable informed decisions. Major clients of Energetics – the U.S. Department of Energy and the New York State Energy Research – respect their obsession with quality products and successful client outcomes.



«Water Management Technology»

As the example of the company activity, we can consider one of many Energetics programs such as Water Management Technology. Everybody knows that population growth, aging water infrastructure and inefficient water usage make the current growth in water demand unstable (Fig. 1: see left) [3, p.3]. An increase in energy production, which requires water for cooling and emissions control, also contributes to that demand. For these reasons, water and wastewater industries require new approaches to optimize water use, reuse, recycling, and provide security and stability of the water infrastructure.

To reach this goal Energetics and American Society of Mechanical Engineers (ASME) together synthesized the workshop results to develop the new way. It identifies ten high-priority actions that ASME can pursue (Fig. 2) [3, p. 17]. Nowadays there is a number of technologies and tools available for water efficiency and water reuse, but Energetics workgroup clearly see the importance of better communication in needs and benefit, for a wider adaption of water efficiency and water reuse techniques. There is a need for a more thorough understanding of water use within specific industries to determine the best place for further assessment and action. Consequently, the workgroup identified a number of potential ASME roles that can help improve usage of water power across all the USA [3, p. 18].


Top 10 Priority Activities

- Establish a Community Engagement Platform on Industrial Water Reuse Management Technology
- Establish ASME Awards/Recognition for Outstanding Water Reuse Projects, Equipment, and Activities
- Develop Industry-Specific Workshops to Promote and Capture BMPs
- Produce Industry Case Study Resource Guide
- Create Water Efficiency Codes and Standards Within Areas of Expertise
- Use Thermal Pinch Experience to Promote Water Pinch
- Develop On-Line Tool Analogous to the Produced Water Management Information System
- Define "10 Great Challenges" for Industrial Water Reuse
- Identify Industries Best-Suited for Water Reuse
- Establish Benchmarking through Case Studies

Fig.2. Ten high-priority actions for ASME.

Conclusion

So, in conclusion, I think it is necessary to say that Energetics is the successful growing company which committed itself to develop their staff and improve our world. It is a great company with a wide range of products for employees to work on and gives them a lot of flexibility and independence. If you had some problems with optimization of your production, you could freely access to Energetics. There are many engineering companies in the world and Energetics is one of the best.

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Beck, P.A.

Underground cables

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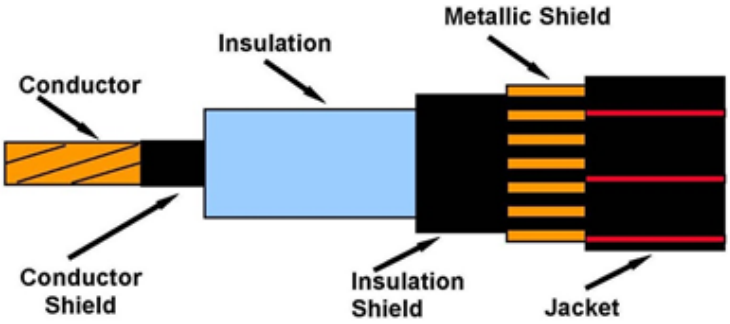
Underground cables are part of the electric transmission system designed for underground installation. Their main purpose is the transmission of electrical energy. Undergrounding refers to the replacement of overhead cables providing electrical power or telecommunications, with underground cables. This is typically performed for aesthetic purposes. In figure 1 below one can see how cables can improve the visual impact to people and surroundings.

Figure 1 (left) – Before and after laying underground cables.

One of the commonly used types of underground cables is an extruded dielectric cable which consists of the following components:

- Conductor – Typically aluminum or copper. It carries current and voltage.
- Strand Shield – It is applied over the conductor to form a smooth, concentric shape preventing insulation from flowing into the strands.
- Insulation – Typically rubber (EPR) or plastic (XLPE or TR XLPE.) It insulates the medium voltage conductor from ground.
- Insulation Shield – It controls the stress within the insulation and is part of the dead-front configuration.
- Metallic Shield – Typically copper or aluminum, but may also be lead. The shape can be concentric neutrals, copper tape, longitudinally corrugated copper tape, drain wires, flat strap, or lead sheath.
- Outer Jacket – It provides protection to the metallic shield that helps prevent moisture from attacking the shield or migrating into the insulation where it can cause trees and potential cable breakdown.[1].

Figure 2 (right) – Construction of an underground cable.



In Figure 2 one can see construction of underground cable.

Underground cables are known to have certain advantages in comparison with overhead lines. Among them:

- Less subject to damage from severe weather conditions.
- Greatly reduced emission, into the surrounding area, of electromagnetic fields.
- Underground cables pose no hazard to low flying aircraft or to wildlife.

Figure 3 (left): Damage of overhead lines and reliability of underground cables from severe weather conditions.

- Much less subject to conductor theft, illegal connections, sabotage, and damage from armed conflict.

In figure 3 one can see why underground cables are less subject to damage from severe weather conditions.

On the other hand, underground cables also have disadvantages:

- Undergrounding is more expensive, since the cost of burying cables at transmission voltages is several times greater than overhead power lines.
- Underground repairs can take days or weeks, and for this reason redundant lines are run.
- Underground cable locations are not always obvious, which can lead to unwary diggers damaging cables or being electrocuted.
- Underground cables are more subject to damage by ground movement.[2].

Figure 4 (right): Repair of underground cable.In figure 4 one can see repairs of underground cables.

To sum up, using undergrounding can increase the initial costs of electric power transmission and distribution but may decrease operational costs over the lifetime of the cables. Underground cables can transmit power across densely populated areas or areas where land is costly or environmentally or esthetically sensitive. Underground and underwater crossings may be a practical alternative for crossing rivers.

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SCADA – Supervisory control and data acquisition

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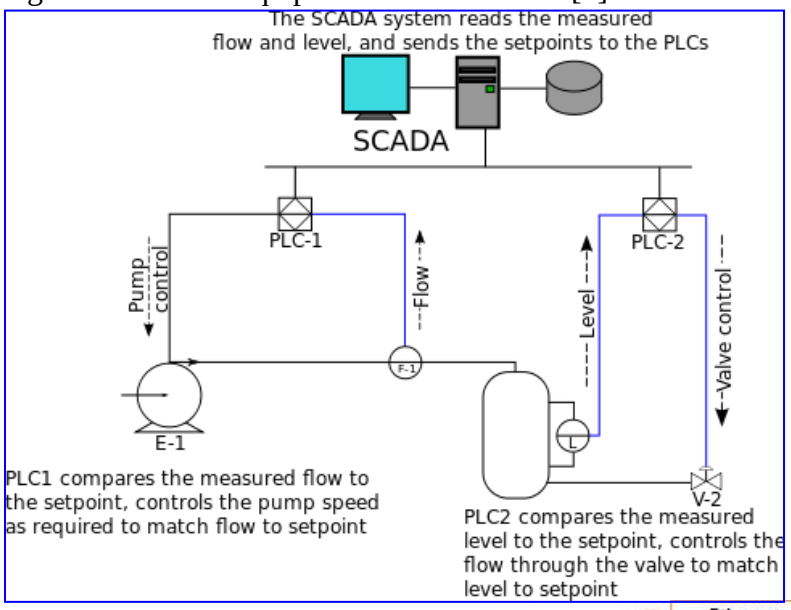
SCADA (supervisory control and data acquisition) is a kind of software application program used for the process of control and gather real time from remote locations for exercising this control on equipment and conditions [1].



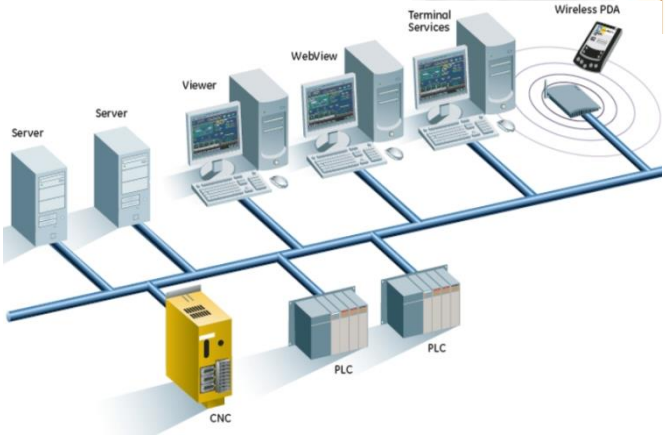
SCADA is based on PCs computerized system and is a way to monitor and control the equipment which simplifies detection of faults and can be used as a control mechanism.

Fig.1 (left). Schematic overview of SCADA [2].

SCADA solves such critical problems as a real-time monitoring, assessment of various parameters, control of devices, protection of the system from faults, and transmission the data from external instruments and control devices to PCs located in control unit.

Fig.2 (right). The ways of data transmission.

SCADA finds use in power plants, oil and gas refining, transportation, telecommunication, various treatment plants, in control of waste and water.



SCADA can be used in many different applications and facilities such as:

1) HMI – A human –machine interface which represents information about the technological process to a human operator, while the human operator controls it.

2) Networks – a set of PC's connected to each other with server and various controlled devices.

Fig.3 (left). Network.

3) Controllers, that interfaces with peripheral devices.
4) Databases where information collected.

SCADA forms the heart of power systems supervision and remote control systems. SCADA is a significantly important and progressive used in national infrastructures way to develop automatic of power stations and substations. However, SCADA systems may have security vulnerabilities, so the systems must identify risks and make the solutions to fetch down those risks.

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Types of Substations Differences in Equipment and Functions

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Introduction

A substation is a part of an electrical generation, transmission, and distribution system. Substations transform voltage from high to low, or the reverse, or perform any of several other important functions. Between the generating station and consumer, electric power may flow through several substations at different voltage levels.

Substations may be owned and operated by an electrical utility, or may be owned by a large industrial or commercial customer. Generally substations are unattended, relying on SCADA for remote supervision and control.

A substation may include transformers to change voltage levels between high transmission voltages and lower distribution voltages, or at the interconnection of two different transmission voltages. The word substation comes from the days before the distribution system became a grid. As central generation stations became larger, smaller generating plants were converted to distribution stations, receiving their energy supply from a larger plant instead of using their own generators. The first substations were connected to only one power station, where the generators were housed, and were subsidiaries of that power station.

Elements of a substation

Substations generally have switching, protection and control equipment, and transformers. In a large substation, circuit breakers are used to interrupt any short circuits or overload currents that may occur on the network. Smaller distribution stations may use recloser circuit breakers or fuses for protection of distribution circuits. Substations themselves do not usually have generators, although a power plant may have a substation nearby. Other devices such as capacitors and voltage regulators may also be located at a substation.

Substations may be on the surface in fenced enclosures, underground, or located in special-purpose buildings. High-rise buildings may have several indoor substations. Indoor substations are usually found in urban areas to reduce the noise from the transformers, for reasons of appearance, or to protect switchgear from extreme climate or pollution conditions.

Where a substation has a metallic fence, it must be properly grounded to protect people from high voltages that may occur during a fault in the network. Earth faults at a substation can cause a ground potential rise. Currents flowing in the Earth's surface during a fault can cause metal objects to have a significantly different voltage than the ground under a person's feet; this touch potential presents a hazard of electrocution.

Types

Substations may be described by their voltage class, their applications within the power system, the method used to insulate most connections, and by the style and materials of the structures used. These categories are not disjointed; to solve a particular problem, a transmission substation may include significant distribution functions, for example.

Transmission substation

A transmission substation connects two or more transmission lines. The simplest case is where all transmission lines have the same voltage. In such cases, substation contains high-voltage switches that allow lines to be connected or isolated for fault clearance or maintenance. A transmission station may have transformers to convert between two transmission voltages, voltage control/power factor correction devices such as capacitors, reactors or static VAR compensators and equipment such as phase shifting transformers to control power flow between two adjacent power systems.

Transmission substations can range from simple to complex. A small "switching station" may be little more than a bus plus some circuit breakers. The largest transmission substations can cover a large area (several acres/hectares) with multiple voltage levels, many circuit breakers and a large amount of protection and control equipment (voltage and current transformers, relays and SCADA systems). Modern substations may be implemented using international standards such as IEC Standard 61850.

Distribution substation

A distribution substation transfers power from the transmission system to the distribution system of an area.[2] It is uneconomical to directly connect electricity consumers to the main transmission network, unless they use large amounts of power, so the distribution station reduces voltage to a level suitable for local distribution.

The input for a distribution substation is typically at least two transmission or subtransmission lines. Input voltage may be, for example, 115 kV, or whatever is common in the area. The output is a number of feeders. Distribution voltages are typically medium voltage, between 2.4 kV and 33 kV depending on the size of the area served and the practices of the local utility. The feeders run along streets overhead (or underground, in some cases) and power the distribution transformers at or near the customer premises.

In addition to transforming voltage, distribution substations also isolate faults in either the transmission or distribution systems. Distribution substations are typically the points of voltage regulation, although on long distribution circuits (of several miles/kilometers), voltage regulation equipment may also be installed along the line.

The downtown areas of large cities feature complicated distribution substations, with high-voltage switching, and switching and backup systems on the low-voltage side. More typical distribution substations have a switch, one transformer, and minimal facilities on the low-voltage side.

Collector substation

In distributed generation projects such as a wind farm, a collector substation may be required. It resembles a distribution substation although power flow is in the opposite direction, from many wind turbines up into the transmission grid. Usually for economy of construction the collector system operates around 35 kV, and the collector substation steps up

voltage to a transmission voltage for the grid. The collector substation can also provide power factor correction if it is needed, metering and control of the wind farm. In some special cases a collector substation can also contain an HVDC converter station.

Collector substations also exist where multiple thermal or hydroelectric power plants of comparable output power are in proximity. Examples for such substations are Brauweiler in Germany and Hradec in the Czech Republic, where power is collected from nearby lignite-fired power plants. If no transformers are required for increase of voltage to transmission level, the substation is a switching station.

Converter substations

Substations may be associated with HVDC converter plants, traction current, or interconnected non-synchronous networks. These stations contain power electronic devices to change the frequency of current, or else convert from alternating to direct current or the reverse. Formerly rotary converters changed frequency to interconnect two systems; such substations today are rare.

Switching substation

A switching substation is a substation without transformers and operating only at a single voltage level. Switching substations are sometimes used as collector and distribution stations. Sometimes they are used for switching the current to back-up lines or for parallelizing circuits in case of failure. An example is the switching stations for the HVDC Inga –Shaba transmission line.

A switching substation may also be known as a switchyard, and these are commonly located directly adjacent to or nearby a power station. In this case the generators from the power station supply their power into the yard onto the Generator Bus on one side of the yard, and the transmission lines take their power from a Feeder Bus on the other side of the yard.

Classification by structure

Outdoor, above-ground substation structures include wood pole, lattice metal tower, and tubular metal structures, although other variants are available. Where space is plentiful and appearance of the station is not a factor, steel lattice towers provide low-cost supports for transmission lines and apparatus. Low-profile substations may be specified in suburban areas where appearance is more critical. Indoor substations may be gas-insulated switchgear (at high voltages), or metal-enclosed or metal-clad switchgear at lower voltages. Urban and suburban indoor substations may be finished on the outside so as to blend in with other buildings in the area.

A compact substation is generally an unmanned outdoor substation being put in a small enclosed metal container in which each of the electrical equipment is located very near to each other to create a relatively smaller footprint size of the substation.

Automation

Early electrical substations required manual switching or adjustment of equipment, and manual collection of data for load, energy consumption, and abnormal events. As the complexity of distribution networks grew, it became economically necessary to automate supervision and control of substations from a centrally attended point, to allow overall coordination in case of emergencies and to reduce operating costs. Early efforts to remote control substations used dedicated communication wires, often run alongside power circuits. Power-line carrier, microwave radio, fiber optic cables as well as dedicated wired remote control circuits have all been applied to Supervisory Control and Data Acquisition (SCADA) for substations. The development of the microprocessor made for an exponential increase in the number of points that could be economically controlled and monitored. Today, standardized

communication protocols such as DNP3, IEC 61850 and Modbus, to list a few, are used to allow multiple intelligent electronic devices to communicate with each other and supervisory control centers. Distributed automatic control at substations is one element of the so-called smart grid.

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Voltage control in the electrical network

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The current flow through the elements of the electrical network is attended with losses of voltage. It causes voltage reduction with increasing distance from the power supply. However voltage supplied to the electric consumer can vary slightly from the nominal voltage and should be within acceptable limits. In accordance with State Standard 13109-97 voltage deviation from the nominal value shall not exceed ± 5% for most consumers. In the post-emergency conditions, the duration of which is relatively small, voltage tolerance is increased by 5%. There are also acceptable voltage limit in the high voltage network. In particular, peak working voltage makes from 105 to 120% of nominal value and is determined by conditions of reliable operation of isolation for the high-voltage devices. In the electric power system voltage reductions are determined by the stability conditions of parallel operation of power station generators and load node. In supply networks lower voltage deviations reaches 10-15%. When we assess voltage levels, we should bear in mind that the load are continually changing during the day, therefore voltage losses and voltage levels of power consumers also change.

The electricity transmission scheme (fig. 14.1) demonstrates that it is impossible to ensure compliance the requirements for voltage deviations in modern power system without using special measures and devices. If we assume that on the path from the power generators to the receiver we have four transformation of electric energy. The voltage losses is 5 % at each transformation and 10 % in each of the networks. So the total voltage losses may reach 60%.

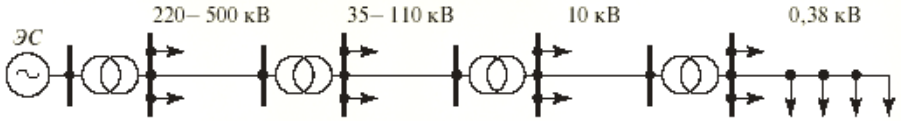

Рис. 14.1. Схема передачи электроэнергии в сети

For ensure acceptable voltage levels in the EPS we use special equipment – regulation devices. Their appointment is the reduction or compensation losses of voltage.

For the analysis of opportunities to reduce voltage losses in elements (lines, transformers), we use the expression.

$$\Delta U = \frac{PR + QX}{U}$$

P,Q – active and reactive powers in the network element;
R,X – resistance and reactance element;
U – the voltage at the end of the element, where we set the powers.

Expression shows that the voltage losses decreases with increasing mains voltage. At operation the change in the nominal mains voltage requires reconstruction of this network. Furthermore, increasing the nominal voltage allows to reduce voltage losses, but it can not be considered as a means of voltage regulation. Decision about the level of nominal voltage

is made based on information about transmitted power and the distance at which this power is transmitted.

Another possibility is the change of power. The active power is reduced due to undersupply of energy customers, and therefore it cannot be used. We can decrease flows of reactive power by installing reactive power sources at consumers. Zero flow of reactive power can be achieved at full RPC, although it is not economically feasible to do.

Another way to have an impact on voltage losses consists in the change of line resistance. Decrease in resistance due to the increase in the cross section of HV line wires or with the inclusion parallel operating elements. However the effectiveness of such measures for supply main is not as high inasmuch as active resistance of elements is substantially less reactance. The reactance of a transmission line can be reduced by incorporating the direct compensation plant (DCP). The direct compensation plant represents capacitance with the reactance X_c (fig.14.2). As a result, the total line resistance decreases and becomes equal to $X_{л\Sigma} = X_L - X_C$, here X_L – inductance of the line. But the use of the DCP only to reduce voltage losses also not economically justified. DCP are used to increase the network capability and steady-state stability of EPS.

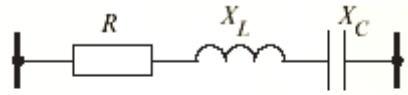

Рис. 14.2. Использование установки продольной компенсации в линии

Nevertheless, the main means of voltage regulation is the use of special technical equipment, which are explained below.

- The synchronous generators.

The power generators not only are sources of reactive power in the power system, but at the same time are the most important means of voltage regulation. The terminal voltage Ug of most generators can vary from $0{,}95U_{\text{ном}} \le U_{\text{г}} \le 1{,}05U_{\text{ном}}$.

The set point voltage can be supported by automatic excitation control (AEC). The voltage at the generator tires can be maintained at a predetermined level only if the reactive power Qg (which is generated by them) is within acceptable limits $Q_{\min} \le Q_{\text{г}} \le Q_{\max}$

When reactive power reaches a limiting value, it is fixed at that value. In this case, the voltage of the generator will be changed as follows: when it reaches the lower limit of the power – to rise, when the upper limit – lower. Nominal reactive power of generator is determined by nominal power factor cosφg. If you need to use a reactive power on the generator by more than nominal, it is possible within certain limits by reducing its active power. In this instance the increase in reactive power will restricted by means of currents in the stator and rotor of the machine.

- The synchronous compensators.

Synchronous compensators allow to support and regulate the voltage within ± 5% at the point of connection by changing the excitation current. As with generators, voltage regulation can be carried out by changing the reactive power within an acceptable range.

- Synchronous thyristor compensators.

Regulation is carried out almost instantly due to the thyristor control system. This is especially important for the stabilization of transient phenomenon in EPS.

- Transformers, autotransformers.

The following devices allow you to change the parameters of the branch of a network: double-wound transformers, autotransformers and three-winding transformers for communication networks of different nominal voltage, linear regulators, working in alliance with autotransformers are all linear controls.

In these devices, one of the windings has a multiple taps, with which you can change the number of active coils of winding. Thereby you can change the transformation ratio. Changing the transformation ratio leads to a change of load voltage at the same voltage supplied to the transformer.

Electricity is distributed from main substation (MS) in distribution networks of urban, rural, industrial consumers. Main substations usually are constructed in the immediate vicinity or within the separate area of electricity consumption. Distribution of electricity inside the area is firstly produced at the voltage of 6-20 kV. Lines 6-20 to (air and cable), are constructed from the MS to the substations, which feed a group of closely spaced small consumers. Their power is supplied through the network of 220-380V. Transformation of electricity from stage 6-20 kV to stage 220-380 V is carried out by means distribution transformers (DT).

In such networks, due to their mass we provide the most simpler and cheaper control devices: distribution transformers with voltage regulation without power, uncontrolled capacitor banks.

In electrical networks with voltage Un ≥ 110 kV regulation of voltage has its own characteristics. These networks are hard-closed structure. They are equipped supervisory control devices, which let you transmit the information about regime parameters at different points of the network to the control centre.

When we consider networks with Un ≥ 330 kV, we must take into account the loss of active power to the crown in the power lines.

The main objective in the design and reconstruction of EPS is complex solution of ensure the balance reactive power and definition of the conditions of voltage regulation in the networks. Also, developers should ensure manageability EPS voltage and reactive power. By this we mean the possibility of providing allowable voltage at all points in the EPS and In the post-emergency conditions of operation. Control is achieved due to right choice of placement, accurate control ranges of the control system.

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On the Economic Ground for Introducing Bioenergetics

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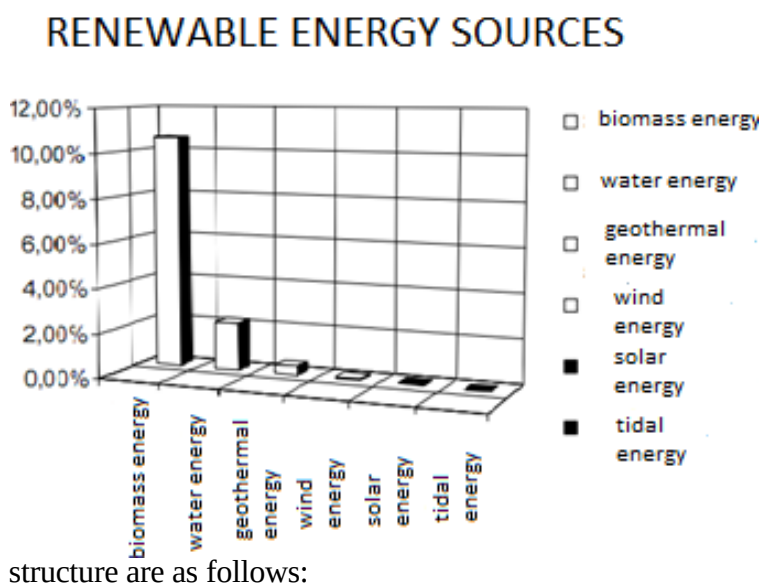
Russia has large reserves of natural resources, giving the possibility to be one of the main exporters of hydrocarbon energy . To reduce the dependence on fossil resources, to strengthen the country's position as an energy power one improves the ecological environment and to conserve resources for the future generations, it is necessary to raise the questions about the possibility of expanding the use of alternative energy sources.



Today the renewable energy in the global energy balance is small – about 11% where most of the energy is biomass (Fig. 1). It is shown in fig 1. (left; Renewables).

This article deals with the renewable energy, the type of such is bioenergy, that makes up 70 % of the total part of renewable sources. One of the most promising subsystems is bioenergy . Biomass energy is based on the use of animal waste . The advantages of this structure are as follows:

- obtaining the energy from waste rapidly renewable raw materials ;
- producing ecologically pure organic fertilizer wild-type ;
- waste managing and environmental improving in the areas of the agricultural production and processing;
- new jobs creation ;
- software installed power the country's agriculture by having a stable centralized power supply.

The main motive for using alternative sources in Russia may be economic incentives, and in their absence – measures direct administration arising from a well-defined position of the state . Under the economic stimulus is meant economic feasibility of bioenergy plants, their payback possible winnings from their use in the form of lower taxes and receive benefits from the state.

Nevertheless, the government's position as to using of renewable energy, including biomass, while is not legally expressed. Benchmark can only be a number of decisions of the Government and the President of the Russian Federation on energy efficiency and resource conservation .According the most experts, the problem of bioenergy development in our country is due to the negative impact of the following factors:

- the lack of the government programs bioenergy and appropriate legislative framework;
- the lack of a coordinating body for bioenergy ;
- the ineffective stimulation participants bioenergy sector ;
- the lack of the financial resources and investment, affordable loans, tax breaks and incentives.

Recently, however, the state began paying an attention to the bioenergy development in the country. Today, with the leading scientific centers of Russia in the field of agricultural mechanization has been established the Center for Bioenergy Development, which is developing the program for the development of bioenergy, the mechanisms of state sub-sector, the creation of the opportunities for joint implementation projects requiring more funds to the Russian and foreign investors.

Currently the field of agricultural mechanization has established drafting the law "On the basis of bioenergy development in the Russian Federation ." The purpose of this Federal Law is a legal framework for implementing the unified state policy in the sphere of agriculture and forestry in the country of production of biomass, biofuels production from it and its

consumption, the development of the country wide using biofuels in various sectors of the economy, especially in agriculture by achieving environmental improvements in the country.

Everything also there is the issue price in the use of biogas plants . This is one of the most significant expansion of the brakes in the implementation of bioenergy . Without the government funding, even in some privileges, Russian enterprises could hardly afford the use of biogas plants to produce their own energy. However, to date the budget allocation subroutine development of alternative energy has already reached 1.5 billion rubles . and continues to grow . The projections for the nearest future, namely 2020, investment volume will have amounted to 19 billion rubles . And electricity production based on renewable raw materials, including agricultural waste, will increase from 2.5% to 4.5%.

Thus, when the possibility of financing the bioenergy introduction at agricultural enterprises and when there are significant advantages of biogas plants is a problem of insufficient activity of Russian enterprises management at the regional level, which are still skeptical and vary the idea of using alternative energy sources. It means a slow growth rate of biogas plants. Additional measures to accelerate the implementation of the growth units may be the following :

- the electricity limitation, replacing it with the consumption in excessing the energy generated through the use of biogas plants ;
- the introduction of social norms to use the electricity for agricultural enterprises ;
- the campaign agricultural producers, summing them to solve the environmental problems to use environmentally friendly sources of energy.

The bioenergy development prospect in Russia is very acute because of the lack of widespread use of energy non-conventional sources . However, due to the distinct advantages of using biomass for energy in the nearest future and this industry is bound to get a wide recognition in our country.

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SCADA system design and security

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Modern electric utilities must meet increasing demand for electrical power generation and distribution while coping with decreasing tolerance for disruptions and outages. One of the most cost-effective solutions for improving reliability, increasing utilization and cutting costs is automating the systems by implementing a supervisory control and data acquisition system (SCADA) [1].

SCADA is typically a PC based software package. The system operates with coded signals over communication channels so as to provide control of remote equipment (using typically one communication channel per remote station). The supervisory system may be combined with a data acquisition system by adding the use of coded signals over communication

channels to acquire information about the status of the remote equipment for display or for recording functions [2].

SCADA destination includes data exchange with Remote Control Device (RCD), received data processing, received and processed information display, database maintenance, alarm signaling, preparing and generation of report [1].

SCADA systems are often used by power companies, major Utility Companies, physical sites, manufacturing companies, providers of mass transportation. What concerns power companies, SCADA systems can be used to maximize the efficiency of power generation and distribution processes. More specifically, SCADA systems can monitor the power flow, power line voltage, circuit breaker status, and other electrical processes. SCADA systems can even be used to control individual sections of the power grid [3].

SCADA-system structure incudes:

- Remote Terminal Unit (RTU) – devices deployed in the field at specific sites and locations. RTU's gather information locally from the sensors to report back to the SCADA master unit. RTU's can also issue control commands to the control relays it communicates with.
- Master Terminal Unit (MTU) provides the central processing capability for the SCADA system. Master units connect the human operators to the system with a browser interface that allows the system operator to respond to data gathered from all parts of the network.
- Communication System (CS) provides the connection between the SCADA master unit and the RTU's in the field. It is the all-important link between the far-flung elements of a geo-diverse operation [3].

The three basic functions are the monitoring, control and user interface functions. The monitoring function is to collect data and send it back to the central computer. The control function is to gather data from monitoring sensors, process it and send control signals back to the equipment. The user interface is a large control room where SCADA input and output responses are monitored in real time.

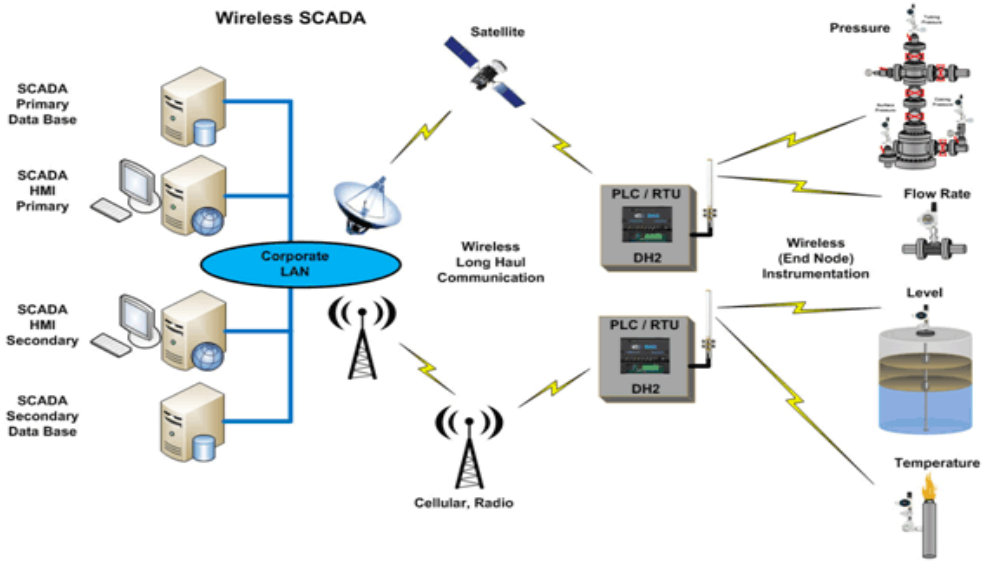

Fig. 1. SCADA-system functions connection.

Today specialists are concerned with providing SCADA security since lots of threats are posed on the system by hackers attempting to penetrate into the network and gain access to control systems. Cyber-attacks on critical infrastructure have highlighted security as a major requirement on smart grid. SCADA system is a technology that helps smart grid to reduce

operational and maintenance cost, ensure the reliability of power supply, and provides tolerant of attacks against physical and cyber security. Hence, without a secure SCADA system, it is impossible to deploy the smart grid system [4].

The cyber security basically can be attacked in three steps as follows:

(1)the attacker has control over the SCADA system,.

(2)the attacker identifies the system to launch an intelligent attack,.

(3)attacker initiates the attack [5].

Attackers at the top level include online hackers, terrorists, workers, opponents, or client, and so on. In order to obtain cyber security it is necessary to build an effective, layered defense system to function broadly across the entire grid infrastructure.

To secure data in the smart grid and SCADA system an encryption is used. Proper key management involves restricting personal access to key storage locations, random key updates and encoded key storage servers. Therefore, key algorithms must be validated in a cryptographic system and kept in locations where they need to be [2].

In addition, a robust hardware designed to withstand cyber threats is needed. One example is managed switches which perform multi-functions like access control, traffic prioritization, managing data flow, and so forth. Another addition to existing systems would be the use of firewalls. They block unauthorized access to any network and work according to the user defined rules [5].

The systems are used to mission critical industrial processes where reliability and performance are paramount. The benefits one can expect from adopting a SCADA system are a rich functionality and extensive development facilities. Modern SCADA systems are increasing in complexity, due to the integration of different components produced in many cases by different manufacturers. Thus, it is necessary to address the security level of each device, as well as on the overall environment and integration tests.

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The Structure of the Modern Power System.

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Abstract

The paper describes the modern power system. This article consists of four main parts. In the first part one can find information about the function of generation subsystem, also learn about generators and transformers? their function and work. The next part deals with trans-

mission subsystem. High voltage transmission lines are terminated in substations, which are called high-voltage substations, receiving substations, or primary substations. The third part provides information about distribution subsystem, which is divided into primery and secondary distribution network. And the final part focuses on load subsystem and kind of consumers.

Introduction

The modern society can't imagine it's life without electricity. A lot of electrical devices are used daily. Your laptop, your telephone or kettle and so on won't work without electricity. And you know it, but who knows how we receive electricity, where and how it appears. Everybody should know it. Because all people, every day, every moment deal with.

The Structure of the Modern Power System.

An interconnected power system is a complex enterprise that may be subdivided into the following major subsystems:

- Generation Subsystem.
- Transmission Subsystem.
- Distribution Subsystem.
- Utilization Subsystem.

Generation Subsystem. This includes generators and transformers.

Generators – An essential component of power systems is the three-phase ac generator known as synchronous generator or alternator. Synchronous generators have two synchronously rotating fields: One field is produced by the rotor driven at synchronous speed and excited by dc current. The other field is produced in the stator windings by the three-phase armature currents. The dc current for the rotor windings is provided by excitation systems. In the older units, the exciters are dc generators mounted on the same shaft, providing excitation through slip rings. Current systems use ac generators with rotating rectifiers, known as brushless excitation systems. The excitation system maintains generator voltage and controls the reactive power flow. Because they lack the commutator, ac generators can generate high power at high voltage,typically 30 kV.

The source of the mechanical power, commonly known as the prime mover, may be hydraulic turbines, steam turbines whose energy comes from the burning of coal, gas and nuclear fuel, gas turbines, or occasionally internal combustion engines burning oil.

Steam turbines operate at relatively high speeds of 3600 or 1800 rpm. The generators to which they are coupled are cylindrical rotor, two-pole for 3600 rpm, or four-pole for 1800 rpm operation. Hydraulic turbines, particularly those operating with a low pressure, operate at low speed. Their generators are usually a salient type rotor with many poles. In a power station, several generators are operated in parallel in the power grid to provide the total power needed. They are connected at a common point called a bus.

With concerns for the environment and conservation of fossil fuels, many alternate sources are considered for employing the untapped energy sources of the sun and the earth for generation of power. Some alternate sources used are solar power, geothermal power, wind power, tidal power, and biomass. The motivation for bulk generation of power in the future is the nuclear fusion. If nuclear fusion is harnessed economically, it would provide clean energy from an abundant source of fuel, namely water.

Transformers – The transformer transfers power with very high efficiency from one level of voltage to another level. The power transferred to the secondary is almost the same as the primary, except for losses in the transformer. Using a step-up transformer will reduce losses in the line, which makes the transmission of power over long distances possible.

Insulation requirements and other practical design problems limit the generated voltage to low values, usually 30 kV. Thus, step-up transformers are used for transmission of power. At the receiving end of the transmission lines step-down transformers are used to reduce the

voltage to suitable values for distribution or utilization. The electricity in an electric power system may undergo four or five transformations between generator and consumers.

Transmission Subsystem

An overhead transmission network transfers electric power from generating units to the distribution system which ultimately supplies the load. Transmission lines also interconnect neighboring utilities which allow the economic dispatch of power within regions during normal conditions, and the transfer of power between regions during emergencies.

Standard transmission voltages are established in Russian Federation transmission voltage lines operating at more than 35 kV are standardized at 110 kV, 220 kV, 330 kV, 500 kV, and 750 kV line-to-line. Transmission voltages above 220 kV are usually referred to as extra-high voltage (EHV).

High voltage transmission lines are terminated in substations, which are called high-voltage substations, receiving substations, or primary substations. The function of some substations is switching circuits in and out of service; they are referred to as switching stations. At the primary substations, the voltage is stepped down to a value more suitable for the next part of the trip toward the load. Very large industrial customers may be served from the transmission system.

Distribution Subsystem

The distribution system connects the distribution substations to the consumers' service-entrance equipment. The primary distribution lines from 4 to 34.5 kV and supply the load in a well-defined geographical area. Some small industrial customers are served directly by the primary feeders.

The secondary distribution network reduces the voltage for utilization by commercial and residential consumers. Lines and cables not exceeding a few hundred feet in length then deliver power to the individual consumers. The secondary distribution serves most of the customers at levels of 380/220 V.

Distribution systems are both overhead and underground. The growth of underground distribution has been extremely rapid and as much as 70 percent of new residential construction is via underground systems.

Load Subsystems

Power systems loads are divided into industrial, commercial, and residential. Industrial loads are composite loads, and induction motors form a high proportion of these loads. These composite loads are functions of voltage and frequency and form a major part of the system load. Commercial and residential loads consist largely of lighting, heating, and cooking. These loads are independent of frequency and consume negligibly small reactive power.

Conclusion

Generation subsystem includes generators and transformers they are essential components of power. An overhead transmission network transfers electric power from generating units to the distribution system which ultimately supplies the load. The distribution system connects the distribution substations to the consumers' service-entrance equipment. Power systems loads are divided into industrial, commercial, and residential. Now, you know what a power system is, how every subsystem works.

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Smart Grid

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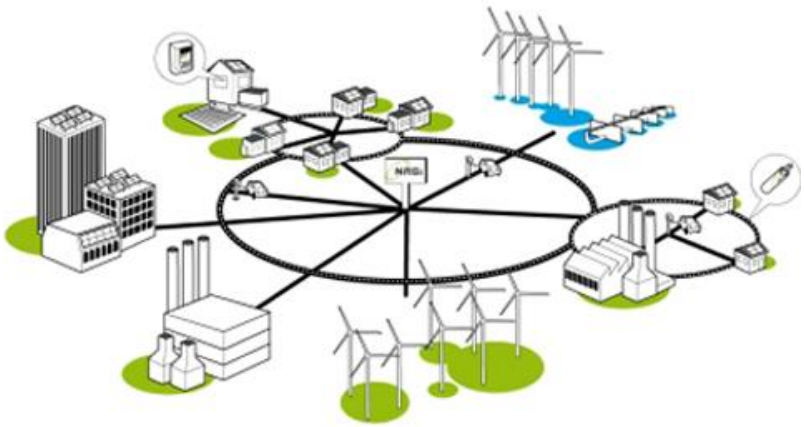
Introduction.

Today, theenergy companieshavea lot of problems: wornand unreliablepower grid, an oldsystem ofone-waytransfer of energy, the nature of supply and demand, moreover, need tofind new andbetter ways tomeet the growing demand for electricity. At the same time consumers are demanding lower tariffs, increasing the reliabilityof services.A smart grid is designed to solve these problems.



A smart grid is a modernized electrical grid that uses information and communications technology to gather and act on information, such as information about the behaviors of suppliers and consumers, in an automated fashion to improve the efficiency, reliability, economics, and sustainability of the production and distribution of electricity [1].

Smart grid policy is organized in Europe as Smart Grid European Technology Platform [2]. Roll-out of smart grid technology also implies a fundamental re-engineering of the electricity services industry, although typical usage of the term is focused on the technical infrastructure.

The objectives of the smart grid

Reliability

Today's grids extend over thousands of kilometers. To transport the maximum possible energy, power flow must be carefully controlled along the length of the system. Automation infrastructure now available at the transmission level must be more widely used in distribution systems to provide seamless connections between power generators and individual consumers [1].

The smart grid will make use of technologies that improve fault detection and allow self-healing of the network without the intervention of technicians. This will ensure more reliable supply of electricity, and reduced vulnerability to natural disasters or attack.

To ensure the maximum flow of electricity through transmission lines, flexible alternating current transmission systems (FACTS) must be active. High voltage direct current (HVDC) connections will be required to stabilize large grids or to connect grids running at different frequencies.

Until now transmission systems have been the focus of technical improvements. Distribution systems are still waiting for extended automation technologies that will upgrade their performance and enhance their reliability.

To minimize problems with reliability and the economic disadvantages they bring, the future electrical system must deliver top performance at every point in the chain from power generation to the individual consumer.

Efficiency

The efficient handling of electrical energy offers a huge saving potential. Today, almost 80 percent of primary energy is lost in transmission to the electricity consumer. Realizing this potential requires optimal power plant processes, efficient transmission and distribution systems and technologies to improve the efficiency of the energy use itself [3].

Numerous contributions to overall improvement of the efficiency of energy infrastructure are anticipated from the deployment of smart grid technology, in particular including demand-side management, for example turning off air conditioners during short-term spikes in electricity price. The overall effect is less redundancy in transmission and distribution lines, and greater utilization of generators, leading to lower power prices.

Sustainability

The International Energy Agency predicts that hydro power will remain the major source of renewable energy for the next two decades, followed by wind and solar. The challenges of integrating these renewable energy sources into the electrical system are different for each technology but the system of the future must accommodate them all [1].

The improved flexibility of the smart grid permits greater penetration of highly variable renewable energy sources such as solar power and wind power, even without the addition of energy storage. Current network infrastructure is not built to allow for many distributed feed-in points, and typically even if some feed-in is allowed at the local (distribution) level; the transmission-level infrastructure cannot accommodate it. Rapid fluctuations in distributed generation, such as due to cloudy or gusty weather, present significant challenges to power engineers who need to ensure stable power levels through varying the output of the more controllable generators such as gas turbines and hydroelectric generators. Smart grid technology is a necessary condition for very large amounts of renewable electricity on the grid for this reason.

Capacity

Meeting the rise in global demand for electricity will mean adding a 1 GW power plant and all related infrastructure every week for the next 20 years. This must be achieved in the most economic way with the most environmentally friendly technologies available. The reduction of carbon emissions is an overriding aim in all these efforts.

The International Energy Agency estimates that between now and 2030, global investments in electrical grid infrastructure of around $6 trillion will be needed to satisfy the world's increasing demand for power [3]. Most of the growth is expected in Asia with the construction of new transmission and distribution systems, but new investments will also be needed in the United States and Europe where aging systems must be replaced. To ensure that a grid's capacity is used as effectively as possible, reserve capacity, which is needed to balance fluctuations in demand and supply, will be minimized and larger cross-country grids with high-capacity connections will be required. Small-scale power generation to serve local needs will be more widely established to support central power generation plants.

Conclusion

Smart grids will provide more electricity to meet rising demand, increase reliability and quality of power supplies, increase energy efficiency, be able to integrate low carbon energy sources into power networks.

Smart grids possess demand response capacity to help balance electrical consumption with supply, as well as the potential to integrate new technologies to enable energy storage devices and the large-scale use of electric vehicles.

Electrical systems will undergo a major evolution, improving reliability and reducing electrical losses, capital expenditures and maintenance costs. A smarter grid will provide

greater control over energy costs and a more reliable energy supply for consumers. Environmental benefits of a smarter grid include reduced peak demand, integration of more renewable power sources, and reduced CO_2 emissions and other pollutants.

Smart grid is the future for electrical systems, as it is designed to meet the four major electricity requirements of our global society: capacity, reliability, efficiency and sustainability.

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Chistikhin, A., Balastov, A.V.

Extensive transmission of power

National Research Tomsk Polytechnic University.

Introduction.

In this article I will tell you about main concepts of power transmission theory, transmissions on the direct and alternating current, I will tell you about advantages of power transmission on the super high voltage and about interrelation between voltage and efficiency in power transmissions.

Transmission of power as creator of power systems

Super high voltage transmissions have a great part in contemporary energetic because they improve reliability of power systems and make them economically beneficial. Humanity has been trying to increase the voltage in power transmission since it was discovered because the increasing of the voltage increases the efficiency of transmission. Moreover the process of developing of energetic in the whole world is characterized with merger of power system in bigger and bigger unions. Of course, it wouldn't happen without strong connection between these power systems. That is why the main goal of power transmission isn't just transportation of electrical power from point «a» to point «b» or spreading around the power from big electric station but creating of large power systems that are considered to be one of the most important parts in contemporary energetics. So power transmissions unite power systems to increase their reliability and provide the most efficiency method of functioning for them.

Constructive properties of transmission lines

Phase splitting of wire is the most important feature of high voltage lines. Every phase is made as special construction from several wires that are located in angles of polygon on the equal distance from each other. There are 2-10 wires in each phase, this amount depend on the voltage of the lines. For example, there are 2 wires in one phase with the voltage of 330 kV and 10 wires in case of 1150 kV. There are several reasons for splitting of phases: 1) increasing of transmission efficiency 2) decreasing intensity for decreasing interferences of electric transmission.

Types of power system

Power system is the connection of power stations by transmission lines for stronger transportation of electricity for consumers. Power systems have some differences from each other in terms of power of stations and types of their functions. Thereby there are 5 types of power stations:

1) Hydro power system that includes more that 50% of Hydro power plants.
2) Heat oriented with more than 50% Combined Heat and Power Plant.
3) Nuclear oriented with more that 50% of nuclear power plant.
4) Systems with equal amount of 3 types of plants.
5) Systems that are consisted only from.

But one the other hand there are systems with mobile structure. So uniting of power systems can be happened due to sectioning of power plants which have big units that can function in several systems that lead to the system of mobile structure, in other words with changing of external impacts that can affect transmission of power, system can change its structure for keeping producing of power on a normal level.

Direct or alternating current?

As you know, the power can be transported by 2 methods: on alternating or direct current. After considering of all factors power engineers chose the most efficiency and beneficial way of power transmission. The main advantage of direct current is that the allowed electric field strength for wires with direct current is much higher than for wires with alternating current. For example, wires that are supposed to function with voltage of 35 kV on alternating current can be used on direct current with 200 kV voltage. That is why despite of its expensive cost, transmissions of direct current is more beneficial in case of extensive transmissions (more than 30 km). But if direct current allows us to increase efficiency of electric transmissions why do we even need transmissions on alternating current? The main answer is in expensiveness of transforming stations that change direct current into alternating current that people use in their electrical appliances and devices. That is why nowadays, there is a great interest in increasing of capacity of transmission on alternating current. Thus, direct current is more beneficial in case of extensive transmission while alternating current is better in local one.

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Davaa, A.V., Tarasova, E.S.

Synthesis of TiC nanopowder

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In recent years, nanopowders have attracted much attention due to their unique properties and suitability for practical applications in various fields of science and technology. Titanium carbide refers to such compounds. It has at least two unique characteristics. Firstly, it is superhard, about 30 GPa: this material is promising for use as superhard abrasives and coat reinforcing polishing materials. Secondly, it is high heat resistant. Titanium carbide is promising for use as a refractory compound in high technology. Titanium carbide still has good

conductivity and low evaporation rate, allowing the use of titanium carbide, for example, as anti-emission coating in the production of electronic devices [1].

There is a problem of obtaining fine powder from metals, alloys, and fine-grain materials, which are intended for a variety of technologies. Thus, this problem has been long discussed in scientific circles. The existing traditional methods are rather complex. The conventional methods are time consuming and requiring bulky and expensive equipment, as well as high energy input, with following safety regulations and environmental safety demands [2].

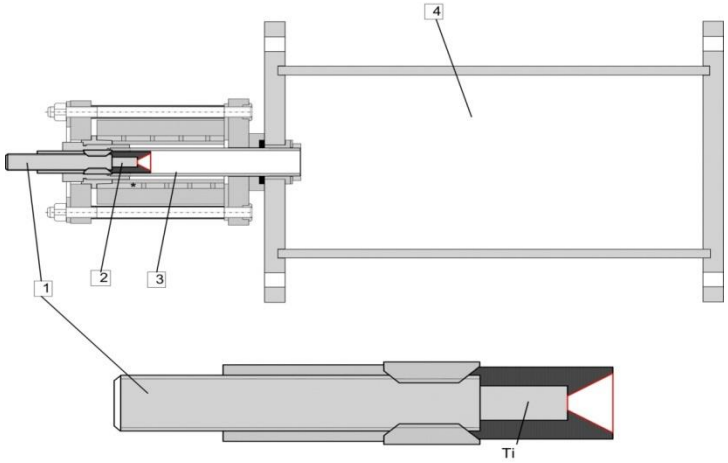


Fig.1 (left). Coaxial magnetoplasma accelerator.

Therefore, experiment was carried out with the aim to investigate the possibility of synthesis titanium carbide nanopowder by means of coaxial magnetoplasma accelerator (CMPA) [2]. CMPA design is shown in Fig. 1. There are a central electrode (1), accelerating channel (3), reactor-camera (5). As precursor titanium is applied carbide powder with an average particle size of 40 microns in the amount of 1,3 g. Power supply of accelerator was carried out by a capacitive storage at a charging voltage of U=2,5 kV and the capacitors C=28,8 mF. Thus, the energy W=90 kJ was supplied.

As a result, dark powder was obtained in reactor-camera. The phase composition of the powder was identified using XRD method. Figure 2 shows the X-ray diffraction pattern of the coating produced by X-ray diffractometer Shimadzu XRD7000 (Cu-Kα). A full analysis of the diffraction patterns of coating was carried out on basis of the program called "PowderCell2.4" and structural data PDF4 +. These results of are presented in Table 1. Dominant phase powder is titanium carbide with the content 83,8%. The average size of coherent scattering for TiC is 55 nm. Judging from average size of coherent scattering, we can say, that powder is nanosized.

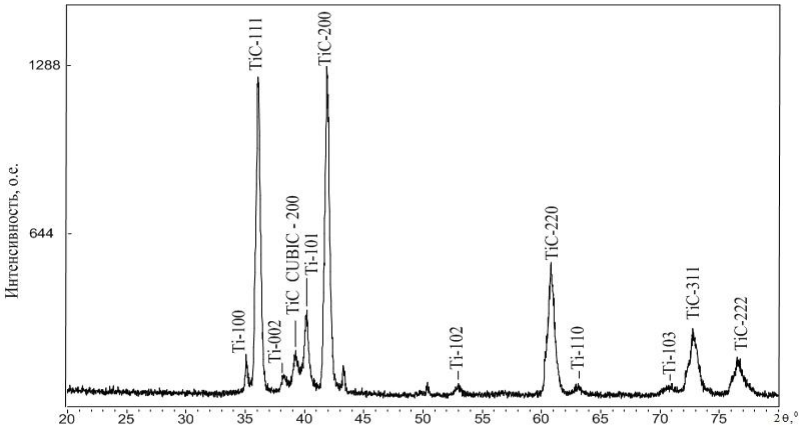
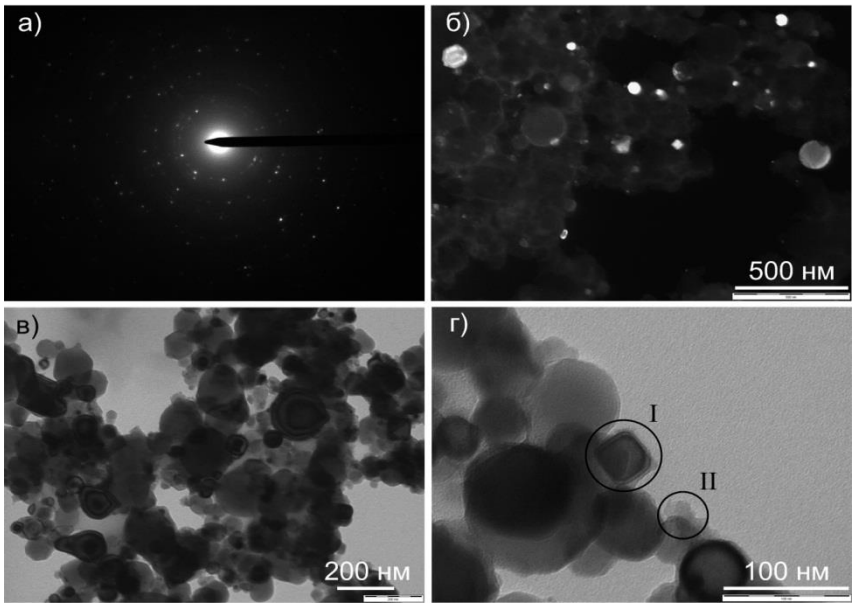


Fig.2. XRD diffraction pattern of the TiC nanopowder.

Table 1. Results of XRD diffraction analysis

Phase, transformation group	Weight, %	CSR, nm	Lattice parameter.experiment/PDF	
			a	c
TiC. F4/m-3 2/m	83,8	55	4,3002/4,3280	-
TiC_CUBIC. F 2 3	4,8	25,7	4,5778/4,6000	-
Ti-ALFA. P6_3/m 2/m 2/c	11,4	74,3	2,9446/2,9505	4,6888/4,6826

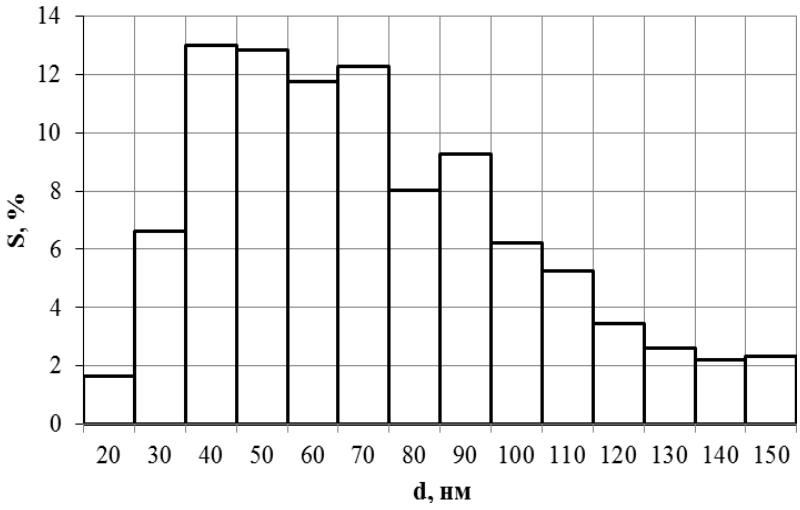
In order to obtain more detailed investigation the powder was analyzed by means of transmission electron microscopy. TEM pattern taken with a microscope Phillips CM 12 are shown in Fig. 3.



A product can be identified two main types of objects. I – is a polygon with an average particle size of 150 nm. II – is invisible objects on this microscope. Dark-field TEM micrograph (Fig. 1.) was obtained by the displacement of the aperture diaphragm to one of the amplitudes. The glow object can be identified as titanium carbide.

Fig.3. TEM pattern of the TiC nanopowder.

Histogram of particle size distribution is constructed using TEM images. By distribution is can be seen that the main part of the particle size ranges from 30 to 100 nm.



In the course of the investigation it has been proved the possibility of synthesis titanium carbide nanopowder in hypersonic jet titanium-carbon plasma generated by CMPA. This conclusion was based on the analysis of the product obtained by XRD, SEM methods.

Fig.4. Histogram of particle size distribution.

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Научн. рук.: Сивков А.А., д.т.н., проф. каф. ЭПП.

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Die Stromversorgung der olympischen Anlagen bei den Winterspielen in Sotschi 2014

Nationale Polytechnische Forschungsuniversität Tomsk.

Im Artikel wird die Situation im Bereich der Stromversorgung in Sotschi behandelt. Sotschi hat drei Unterstation mit 220-kW-Leistung. Das sind Schepsi, Dagomis und Psou, sowie auch die zentrale Unterstation mit 550-kW-Leistung.

Sotschi bezieht Strom durch zwei Stromleitungen von 110 kW mit einer Durchlassfähigkeit von 650MWt.

Zu den Winterspielen 2014 sind weitere Kraftwerke aufgebaut worden: das Kudepst und Dgubginsk. Das Wärmekraftwerk Adler wurde erheblich ausgebaut.

Um Stromausfälle zu vermeiden und die Infrastruktur der Olympischen Spiele zu unterstützen, wurde entschieden, die elektrische Energie zu speichern Das Unternehmen Parker hat ein Energieumwandlungssystem entwickelt, das Energiespeicherelemente (typischerweise große Batteriespeicherblöcke) an das Netz anschließt, um Bedarfsschwankungen effizient auszugleichen. Das System kann in verschiedenen Modi laufen, z. B. Echtzeitlieferung, Spitzenlastabdeckung und andere.

50 Brigaden von 248 Menschen müsen für die Kontrolle der Stromleistungen sorgen. 700 km Hochspannungsleitungen und 2500 km Erdkabel sind instandgesetzt worden. 500 Elektrizitätswerke sind gebaut worden.

Während der Arbeiten wurden zahlreiche innovative technische Lösungen realisiert worden, z.B. mehrkantige Freileistungsmasten und Erdkabel.

Die Vorteile mehrkantiger Freileistungsmasten sind Adaptionsfähigkeit, Lebensdauer, Betriebssicherheit, ästhetische Wirkung, Transportfähigkeit und andere.

Erdkabel besitzen gegenüber Freileitungen einige Vorteile. Sie sind gegen Beschädigungen hervorragend geschützt. Außerdem ist bei niedrigen Spannungen ihre elektromagnetische Verträglichkeit erheblich besser. Erdkabel stören das Landschaftsbild weniger als Freileitungen. Außerdem gefährden sie im Gegensatz zu Freileitungen Vögel nicht.

Große Mengen an Bauarbeiten wurden durchgeführt. Im Rahmen einer komplexen Prüfung der Systeme zur Stromversorgung der Olympischen Objekte in Sotschi wurde eine hohe Zuverlässigkeit des Stromnetzes bestätigt.

Dikovich, V.V.

Active power and frequency control

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Abstract.

The objectives of this report are to describe principles by which large multi-area power systems are controlled and to anticipate how the introduction of large amounts of active power production might require control protocols to be changed. Frequency-and-power control is one of a large number of engineering issues [2].

Introduction.

The fundamental principles by which the power system is controlled and operated are those of the existing fleet of generating plants. These plants are based on synchronous generators driven by turbines that are intended to operate at substantially constant speed.

Active power and frequency control.

The level of frequency in an electric energy system is the most important characteristic of the energy system. The frequency value represents the correlation between the balance of the generated and consumed active power in the energy system. Also the frequency level is an indicator of the quality of the electric energy and shows in the work regimes that exist in the energy system at the present moment. In Russia the level of frequency in the normal regime of work is 50 Hz.The electric energy system has such characteristics as:

- correspondence between the production and consumption of the electrical energy at each moment of time;
- lack of large electric energy storage devices.

These characteristics define the requirements for the electric energy system. They must respond to the requirements in cost-effective issues, in reliability of electric energy supply and quality of supply.

These features require continuous monitoring of the energy balance. Frequency responds to all these requirements.

In the course of the electric energy system work there occurs an imbalance of active power which is caused by instability of consumption, disconnections of generators or power transmission lines. These imbalance events in active powers produce changes in the level of frequency.

All consumers of active electrical energy depend on the level of frequency. Reducing the frequency level will produce the reduction of productivity of the motors and other loads. Also such reduction of frequency has a negative effect on the generator. Namely reduction of frequency will cause reduction of the active power which is produced by the generator. Reduction of generated active power will cause reduction in performance of the auxiliary mechanism at the power station. In its turn this will cause reduction of the active power of the turbine generator which in turn will cause the deficiency in the energy system capacity disposal power, so the frequency will reduce yet more. This effect is called frequency avalanche.

The frequency avalanche can cause the emergency operation of the power generating device.

Frequency regulation requires servicing, with changes in output power within short times. The frequency signal regulation limits the amount of energy delivery which is required for its provision.

There exist different methods which are available for frequency regulation; they include an increase or decrease in generation powers. Each of these methods has pros and cons, and the realization of these methods takes from a millisecond to minutes.

The most common methods for frequency regulation are primary and secondary frequency control. These methods are based on the changes in rotation speed of the turbine by means of changes in supplying the fuels to the boiler. This means that the rotation frequency of the generator will change and respectively alternating current frequency in the grid will also change.

Another opportunity is to use special equipment – automatic frequency load shedding. This device controls the level of frequency and reacts to the sudden change in frequency. After the reaction the automatic frequency load shedding disconnects part of the load. As a result the load reduces but the active power remains the same and the power balance and frequency, in the electric energy system, restores.

The frequency of a power system is dependent on the real power balance. A change in real power demand at one point of a network is reflected throughout the system by a change

in frequency. Therefore, system frequency provides a useful factor to indicate system generation and load imbalance [1].

Conclusion.

The level of frequency in an electric energy system is the most important characteristic of the energy system. The frequency of a system is dependent on active power balance. As frequency is a common factor throughout the system, a change in active power demand at one point is reflected throughout the system by a change in frequency.

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Ermakowa, E.E., Kobenko, Ju.W.

Die Solarkraft: Produktion der Photovoltaikanlagen

Nationale Polytechnische Forschungsuniversität Tomsk.

Die Energie ist eines der am meisten diskutierten Begriffe heute. Die Menschheit braucht Energie, die Notwendigkeit dafür steigt jedes Jahr. In diesen fossilen Reserven von natürlichen Brennstoffen sind nicht unendlich. Es ist daher notwendig, um erneuerbare Energiequellen zu entwickeln. Eine der beliebtesten Formen der erneuerbaren Energien ist die Solarenergie. Potenzielle Energie basiert auf der Verwendung von direktem Sonnenlicht mit extrem hoher Effizienz.

Die solaren Photovoltaikanlagen sind elektronische Geräte, die das Sonnenlicht in Strom umwandeln. Mehrere verbundene Photovoltaikanlagen machen eine Solarbatterie aus. In den Städten ist es bereits möglich, diese Batterien auf Dächern platziert zu sehen.

Die einfachste Solarzelle wird aus Silizium hergestellt und stellt zwei dünne Platten dar, von denen jede bestimmte Verunreinigungen enthält. In einer von ihnen ist ein Überschuss an Valenzelektronen und in der zweiten faulen sie. Zwischen den Platten befindet sich eine isolierende Schicht. Wenn die Lichtschranke an dieser Stromversorgung angeschlossen ist, werden die Elektronen unter ihrem Einfluss die Isolationsschicht und überwinden und durch den Halbleiter fließt der Strom. Ein ähnliches Verfahren findet unter Einwirkung von Sonnenlicht statt. Photon des Lichts dringt in Halbleiter, teilt sie in Elektronen und Protonen. Sie eilen zu den entgegengesetzt geladenen Platten, überwinden leicht die isolierende Schicht. Als ein Ergebnis beträgt in einem Halbleiterpotentialdifferenz etwa 0,5 V. Die Stromstärke ist proportional zu der Anzahl der empfangenen Photonen, die von der Fläche des Halbleiter- Strahlungsintensität und Belichtungszeit abhängt.

Eine sehr wichtige Rolle wird von Anti-Reflex- Beschichtung und der Fähigkeit, Licht zu Material, aus dem die Platte von der Fotozelle führen, gespielt. Moderne Solarzellen unterscheiden sich voneinander entsprechend diesen Parametern. Jetzt sind auf dem Markt Solarzellen, amorphen, poly-und monokristallinen Typs. Effizienz der beiden letzteren ist nicht sehr verschieden, die Leistung amorphen Solarzellen wesentlich geringer ist.

Unter den Materialien führt die Herstellung von Silizium-Solarzellen. Aber es gibt auch so genannte Dünnschicht-Solarzellen, die Kupfer-Indium-Diselenid und enthalten.

In modernen Solaranlagen werden manchmal Hybridmethoden benutzt. Oberhalb dieser Geräte werden in der Dünnschicht-Elemente angeordnet, und unter ihnen – Silizium, die auch nicht über die Photonen, da nur oberen Rastelemente des Spektrums. Diese Solarbatte-

rie nimmt weniger Platz und hat einen Wirkungsgrad von mehr als gewöhnlich. Produktion von Solarzellen wird schnell entwickelt, deren Qualität verbessert wird, und die Preise sind niedriger. Daher sind Sonnenkollektoren immer mehr und mehr beliebt bei den Verbrauchern.

Jüngst startete eine dänische Firma «Mekoprint A / S» die erste Linie, die Polymer-Solarzellen produziert wird. Das Unternehmen ist über 10 Jahre in der Design-Arbeit und nun bereit für die Massenproduktion solcher Batterien.

Die Herstellung stellt ein Druckverfahren dar, bei dem das Solarelement auf eine flexible Oberfläche gedruckt wird, die gedreht und geschnitten wird. Aus dem Film können Batterien in beliebiger Größe gemacht werden.

Jetzt beginnt eine neue, bedeutende Phase der Energieerzeugung. Die Energie erscheint "ökologisch" und "rein". Allerdings gibt es noch viel Arbeit in der Entwicklung der erneuerbaren Energien, insbesondere der Solarenergie, sowie verbesserte Methoden für die Produktion von Solarenergie.

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Wind energy

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Introduction

Wind is the most attractive renewable energy sources: wind energy is cheap, available, almost inexhaustible and does not result in environmental pollution. However, there is a problem of using wind energy – its variability.

The technical potential of wind energy Russia is estimated over 50,000 billion kWh · h / year. The economic potential is about 260 billion kWh · h / year, or about 30 percent of all electricity production in Russia [1].

Wind energy zones in Russia are located mainly on the coast and islands of the Arctic Ocean from the Kola Peninsula to Kamchatka, in the areas of Lower and Middle Volga and the Don, the Caspian, Okhotsk, Barents, Baltic, Black and Azov Seas. Individual wind zones are located in Karelia, Altai, Tuva, Lake Baikal.

Maximum wind speed in these areas is in the autumn-winter period – the period of the greatest demand for electricity and heat. About 30% of the economic potential of wind power is concentrated in the Far East, 14% – in the Northern economic region, about 16% – in Western and Eastern Siberia.

The total installed capacity of wind power plants in the country for 2009 is 17-18 MW.

Power wind turbine depends on the area swept by blades of a generator, and height above a surface.

Air flows at ground / sea are laminar – lower layers inhibit layers located above. This effect is visible to height of 1 km, but sharply reduced even at altitudes more than 100 meters. Height of a generator above this boundary layer at the same time allows you to increase a diameter of blades and frees space on the ground for other activities. Modern generators have reached this abroad and their number is rapidly growing in the world. Output wind generator power is proportional to the third degree of the wind speeds: if the wind increases twice from 5 m / s to 10 m / s, the power is increased by eight times.

Coastal areas are the most perspective places for wind energy production. But the cost of investment compared with a land above 1,5 – 2 times. On the sea, at a distance of 10-12 km

from the coast (and sometimes more), offshore wind farms are built. Tower of wind turbines are mounted on foundations of piles, hammered to a depth of 30 meters.

Other types of subsea foundation and floating base may be used. The first prototype of floating wind turbine was built by H Technologies BV in December 2007. 80 kW wind turbine was mounted on a floating platform in the 10,6 nautical miles off the coast of southern Italy on the part of the sea depth of 108 meters.

June 5, 2009 the company Siemens AG and Norway's Statoil announced the installation of the world's first commercial floating wind power turbines of 2.3 MW produced by Siemens Renewable Energy.[2].

Statistics on using wind energy

On June 2012 the total installed capacity of all world wind turbines were 254 GW. The mean increase in the amount of wind power capacity in the world, since 2009, is 38-40 gigawatts per year and is due to the rapid development of wind power in the United States, India, China and Germany. According to the World Wind Energy Assosiation, Predictive power of wind energy by the end of 2012 closer to the value of 273 GW, in fact, it even surpassed the rate and reached 282.4 GW.[3].

According to IEA breakthrough will be happen on the market of renewable energy in 2018. Amount of electricity, produced by renewable sources will be increased to 25% of the total electricity generation in the world. its share was only 20% In 2011, 19% – in 2006 . By 2016, the share of electricity from renewable sources will be more than from nuclear energy and gas. They will become the second largest energy source after coal.

Europe had 44% of installed wind power, Asia – 31%, North America – 22% in 2010.

It is believed that using of wind turbines in home to provide electricity is not effective in Russia because of:

- High cost of inverter about 50% of cost of entire installation.
- High cost of batteries – about 25% of the cost of installation.
- Diesel generator is sometimes added to such an installation to ensure reliable power supply, and it comparable in cost with all equipment.

Currently, despite rising energy prices, the cost of electricity is not any significant value in the majority of production, compared with other expenses; the key for consumers remain reliability and stability of power supply.

The main factors leading to the rise of energy generated from wind turbines, are:

- Need to generate electricity industrial quality ~ 220V 50 Hz (requires of inverter).
- Need to autonomy for some time (requires of batteries).
- Need to long trouble-free operation of consumers (requires of diesel generator).

Atmospheric emissions

1 MW wind turbine reduces annual emissions of 1,800 tons of CO2, 9 tons of SO2, 4 tons of nitrogen oxides .[4].

Estimated Global Wind Energy Council by 2050, the global wind energy will reduce annual CO2 emissions by 1.5 billion tons.[5].

Impact on climate

Wind turbines remove some of the kinetic energy of moving air masses, which leads to reduction of speed of their movement. This reduction could theoretically have a significant impact on the local (and even global) climatic conditions in an area, if wind generators are used massively. In particular, reduction of average wind speed is able to make the climate of the region slightly more continental due to the fact that the slow-moving air masses become warmer in summers and cooler in winters. The extraction of energy from a wind can con-

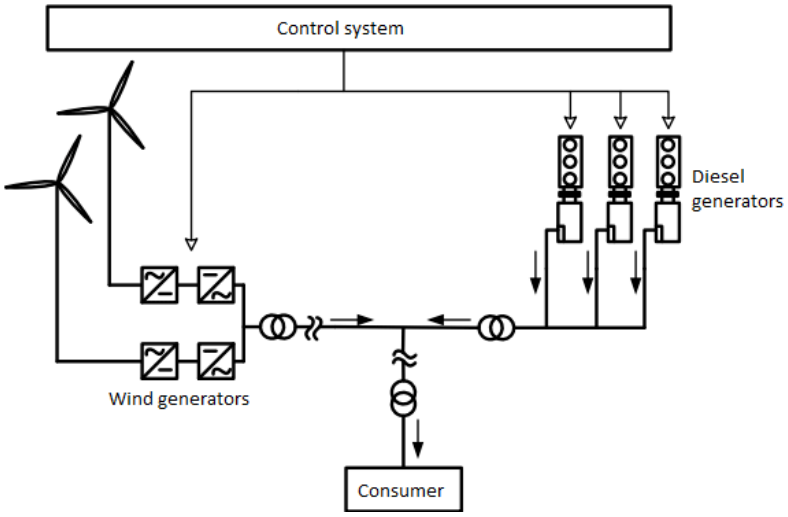
tribute to changes in humidity of the adjacent territory. However, scientists are only beginning research in this area, studies that analyze these aspects do not provide a quantitative assessment of the impact of large-scale wind power on the climate, but allow us to conclude that it may not be as negligible as previously thought.[6].

Wind diesel complex

Wind diesel complex – is a complex including wind turbine and diesel generator. Also a WDC may include inverters, batteries, and ballast load. These units are designed to reduce fuel consumption by diesel power plants in remote areas, where power network is not connected to the grid. This should reduce the expenses for the purchase and delivery of fuel.

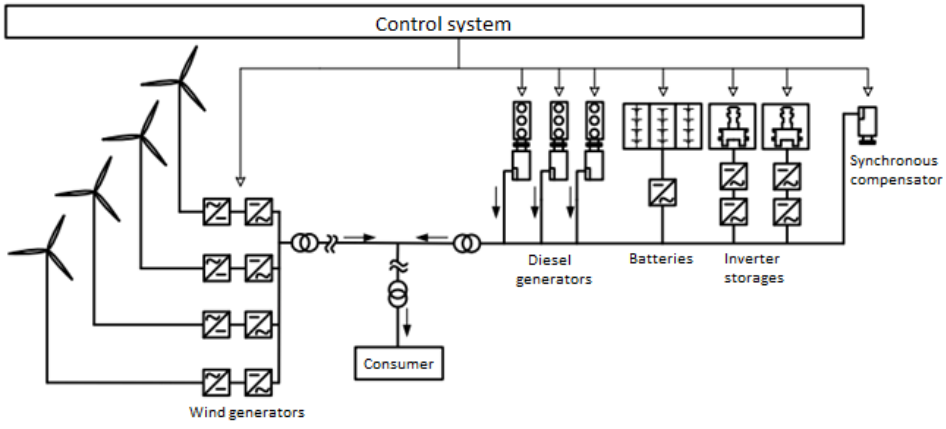
There are two types WDC.

1. Inefficient WDC. To the existing diesel generators connected from 30 to 50% of the design capacity of wind turbines. The diesel generators are complemented by panels of automatically start. However, to preserve the stability of the system, the capacity of wind turbines should not be more than 35% of power of diesel generators. Wind turbines and diesel generators operate in parallel. This solution can theoretically save up to 20 % of fuel consumption of diesel generators.



Picture 1. Inefficient WDC.

2. Highly efficient wind diesel complex. In the work are all designed wind turbines. Thus it is expedient construction of “wind component," generating 100-150% of the required power of electricity. The complex was supplemented with batteries and inertial drives, resulting in (when power and wind speed are sufficient) diesel engine-generators can be derived from work.



Picture 2 (right). Highly efficient WDC.

In the world practice wind diesel complexes are built and operated through a special Federal programs of development of renewable energy, and their task is only to reduce fuel consumption and accumulation of knowledge in the process of operation of such systems. The payback period of the plants are of secondary importance.

With all the advantages, WDC have several disadvantages: application of complex control systems; the lack of commercially available controllers; ob-

ligatory presence of qualified staff; the high cost of construction (up to 6800 euros per 1 kW power); the massive energy accumulators; very long payback period (25 years), often exceeding the lifetime of the individual components of wind diesel system.[7].

Conclusion

The work of the WG is accompanied by noise, vibrations, dangerous for birds that die, getting under rotor blades. And attractive sides of wind power is its inexhaustibility, waste reduction, rapid deployment of wind power almost anywhere, even in remote and inaccessible places, this all forces designers to fight over improving a design of wind turbines.

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Kohlegasifizierungsverfahren

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Russland spielt eine weltweit wichtige Rolle in Reserven und Kohlegewinnung, aber der Anteil der Kohleproduktion liegt nur bei 25 Prozent. In dieser Hinsicht bleiben wir hinter den Ländern wie China, den USA, Indien und anderen, wo die Kohlestromerzeugung 50 bis 75 Prozent beträgt. Der Hauptgrund des Zurückbleibens sind große Mengen billigen Gases. Die großen Reserven und gleiche Verteilung werden die Kohle in zuverlässige Energiequelle verwandeln. Viele Anforderungen, die Emission in der Umwelt reduzieren sollen, machen das Problem der Schaffung der Kohleenergietechnologie aus. Die Anwendung der Vergasungsprozesse begann mit dem XIX. Jahrhundert in Verbindung mit der Entwicklung von Gasstraßenbeleuchtung. Bis zur Mitte des XIX. Jahrhunderts versorgte man Haushalte mit Leuchtgas aus Holz und Kohle, nutzte für die Heizung industrielle Öfen.

Die Kohlevergasung verringert die Emission in die Umwelt aus einem Wärmekraftwerk und nutzt die Kohle in wirkungsvolleren Dampf- und Gasanlagen. Die Vergasung ist ein Hochtemperaturverfahren der Zusammenwirkung des Kohlestoffs mit dem Sauerstoffträger, das Ziel dieses Prozesses ist die Beschaffung der Gase (Methan, Wasserstoff und Kohlenmonoxid). Alle Prozesse der Vergasung unterteilen sich in autothermische, wenn die nötige Wärme aus der Kraftstoffverbrennung hergestellt wird, und allothermische, wenn nötige Wärme von außen zugeführt wird. Prozesse der Kohlevergasung werden nach Partikelgröße klassifiziert: Prozesse, wenn die Partikeln weniger als 1 mm groß sind; Prozesse, wenn die Partikeln bis zu 3 mm groß sind und Prozesse beim stabilen Zustand, wenn die Partikeln mehr als 3 mm groß sind.

Betrachten wir den Vergasungsprozess z. B. am Lurgi-Vergaser. Im Jahr 1932 erfindet der Betrieb Lurgi den Vergaser, der im stabilen Zustand und unter Druck arbeitet. Die Lurgi-Vergaser wurden für grobe Dampf-Sauerstoff-Kohlevergasung (5-30 mm) in der dichten

Schicht verwendet. Die sortierte Kohle liefert man in den Vergaser durch die Schleuse. Dieser Prozess ist beständig, weil die Kohlereserve über dem Verteiler zu groß ist. Die Kohle läuft aus dem Spender durch Entladungsluke nach unten. Die Dampf-Sauerstoff-Mischung hat einen Druck von 3 MPa. Diese Mischung läuft in den Reaktor durch rotierenden Feuerungsrost. Die Ascheschicht, die auf dem Feuerungsrost sich befindet, dient für die Verteilung und Aufheizung. Das Gas, das aus dem Vergaser oben freigesetzt wird, trocknet die Kohle, die hinunterrückt. In der Verbrennungszone wird zu viel Wärme erzeugt, die für thermische Kohlezersetzung benötigt wird. Man nimmt die Asche aus dem Reaktor durch einen Verschluss heraus. Die Kohlestoffpartikeln, die die Vergasung im stabilen Zustand passieren, durchlaufen 4 Stadien: die Abtrocknung, die Wärmeausdehnung, die Vergasung und das Verbrennen.

Der Prozess der Lurgi-Vergasung hat sowie Nachteile als auch Vorteile. Die Vorteile sind: 1) das so genannte Gegenstromprinzip: gute Wärmeübertragung bei geringem Sauerstoffverbrauch; 2) die Vergasung läuft unter Druck, was die Kosteneinsparung bei der Kompression bedeutet. Die Nachteile sind: 1) die Partikeln können nur in einer bestimmten Größe verarbeitet werden, weil kleine Partikeln den Leistungsumfang reduzieren; 2) mit der Vergasung passiert die Wärmeausdehnung der Brennung mit Produkten des Semicokings, die anschließend verarbeitet werden müssen.

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New installation using centrifugal way of the water deaeration

National Research Tomsk Polytechnic University.

Corrosion Control is one of the most important technological and economic challenges of the industrial era. In the first half of the last century corrosion destroyed up to 40% of the total volume of steel produced. For more than 100 years, the efforts of many scientists around the world are directed to methods and technologies to protect structures from corrosion. However, even now, this value is about 20% of the total production of the main structural material – carbon steel.

The Corrosion protection of power equipment and pipelines – one of the priorities in the development of processes for corrosion protection. The importance of this trend explained by the increased importance of energy supply for all industrial enterprises and settlements . The main preventive measure to prevent the corrosion of pipelines and power equipment is deaerated.

Existing equipment for deaeration was developed in the first half of the last century, and practically unchanged continues to be put into projects, installed and operated at thermal power facilities . These bleeders obsolete and contain technical inconsistencies that fail to achieve sustainable gas removal to the required standards in the required range of conditions and loads.

The major corrosive gases include oxygen O2 and carbon dioxide CO2, dissolved in water when it is in contact with atmospheric air.

The traditional way of deaeration.

As you know, deaerator is a thermal power important element. It is an air removing device. Because too mach corrosion is very dangerous for metal. The gases will increase corrosion of the metal.

Degasser usually domed section includes a vertical deaerating, mounted on top of horizontal cylindrical vessel which serves as a boiler feed water tank from which the air is removed.

Deaerator types.

There are many different horizontal and vertical deaerators available from a number of manufacturers, and the actual construction details will vary from one manufacturer to another one. Figures 1 and 2 schematically illustrate two types of unit elements deearatorov.

Tray-type deaerator.

The typical horizontal tray-type deaerator has a vertical domed deaeration section mounted above a horizontal boiler feedwater storage vessel. A boiler feedwater enters the vertical deaeration section above the perforated trays and flows downward through the perforations. Low-pressure deaeration steam enters below the perforated trays and flows upward through the perforations. Some designs use various types of packing material, rather than perforated trays, to provide good contact and mixing between the steam and the boiler feed water.

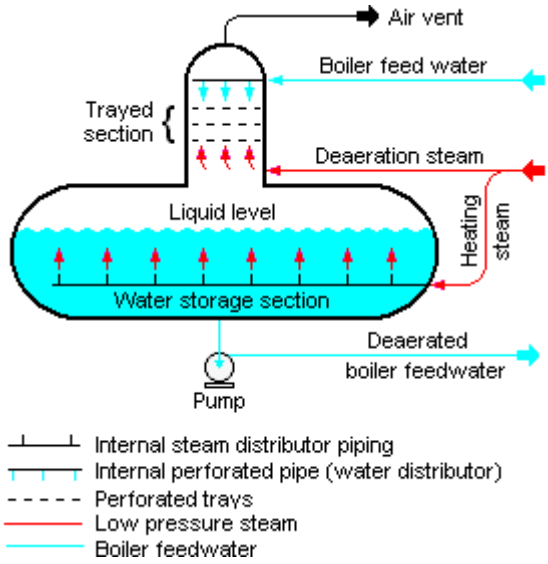

Figure 1: A schematic diagram of a typical tray-type deaerator.

The steam strips the dissolved gas from the boiler feedwater and exits via the vent at the top of the domed section. Some designs may include a vent condenser to trap and recover any water entrained in the vented gas. The vent line usually includes a valve and just enough steam is allowed to escape with the vented gases to provide a small and visible telltale plume of steam.

The deaerated water flows down into the horizontal storage vessel from where it is pumped to the steam generating boiler system. The low-pressure heating steam, which enters the horizontal vessel through a sparger pipe in the bottom of the vessel, is provided to keep the stored boiler feedwater warm. The external insulation of the vessel is typically provided to minimize heat loss.

Installation using centrifugal way of deaerationg of water.

An lnstalling using centrifugal method of water deaeration (Fig. 2) consists of housing 1, built in centrifugal separator 2 . Through a central opening in the upper lid 3 of housing 1 extends drain conduit 4

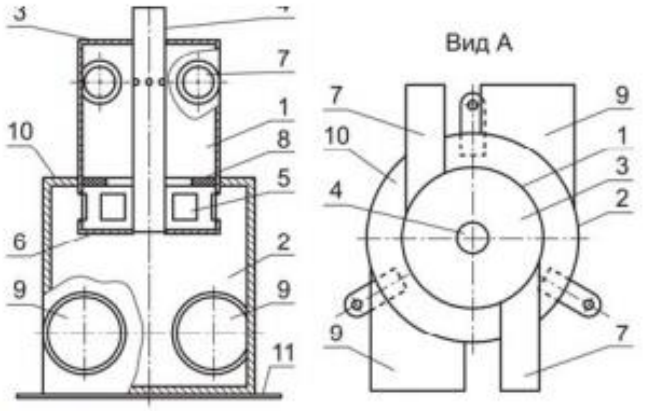

Рис. 2. Конструктивная схема деаэратора ДЦВ-670: 1 – корпус; 2 – центробежный сепаратор; 3, 6 – верхняя и нижняя торцевые крышки корпуса соответственно; 4 – трубопровод отвода выпара; 5 – окна для отвода воды из корпуса; 7, 9 – подводящие и отводящие тангенциальные патрубки соответственно; 8 – кольцевая перегородка (шайба); 10, 11 – верхняя и нижняя торцевые крышки центробежного сепаратора соответственно

vapors . In the housing 1 built into the centrifugal separator 2, windows 5 are located above the bottom end cap of housing 6. Earmarked for the deaeration water, hot relative saturation temperature at the pressure in the vapor space of the deaerator is fed through the tangential Inlets 7. Thanks to the tangential supply, the water flow becomes a rotational movement within the housing. The rotational motion ensures boiling water deaerated part of the rotating flow.

In my diploma work I have calculate the traditional deaerating installation and new, advertized installation using the centrifugal method of the water deaeration. As for my diploma work in future I'd like to find out different deaerating installating economic work. And I hope that my work is progressive and in future it will help people work in this field.

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Synthesis of ultradisperse carbon dioxide powder with plasma-dynamic method in the coaxial magneto-plasma accelerator

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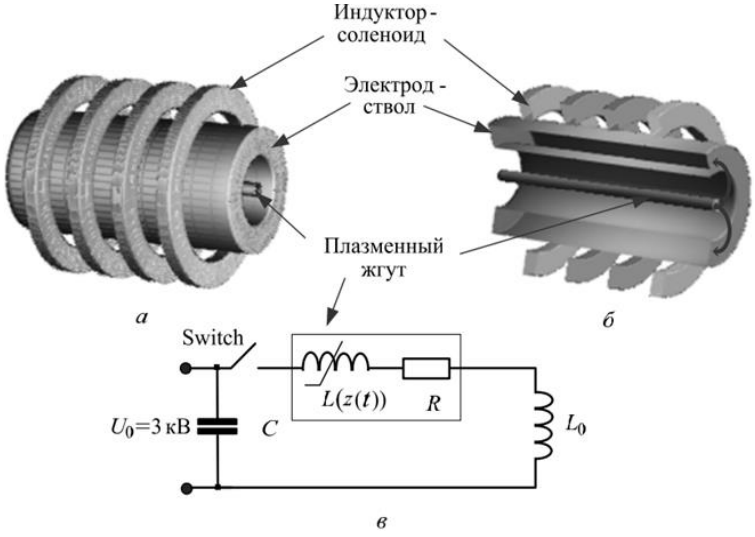
Introduction

Today superconductivity is one of the most promising areas of physics which generates interest of many scientists. However, practical application of high-temperature superconductors is largely limited by the technology.

Literature review shows that currently superconductivity in cuprates results from the copper-oxygen layer where copper atoms form a square grid. Copper atoms are located at grid points, while oxygen atoms are on the lines connecting these points [1][2].



Historical Background

The history of superconductivity is a succeeding discovery of more and more complex structures. It all began with the synthesis of liquid helium, thereby opening the way to the systematic study of the material properties at temperatures close to absolute zero, when the material lose electrical resistance [3] High-temperature superconductors were discovered more than 20 years ago, but still remain a mystery [4].

Figure 1. Simplified model of coaxial magneto-plasma accelerator: a) conductive part; b) cross-section; c) electrical circuit [6].

Coaxial magneto-plasma accelerator

Ultrafine copper oxide powder was synthesized in the coaxial magneto-plasma accelerator designed by TPU scientists [5] This accelerator technology can be used to accelerate plasma to hyperspeed.

The accelerator is designed as a coaxial shaft-electrode system separated by an insulator and placed inside the solenoid. The shaft is cylinder-shaped. On closing the key current flows from the capacitor bank via solenoid coils, passes through the shaft and central electrode to the capacitor through the switch.

Arc discharge results from the insulator surface breakdown.

Plasma is compressed by the intrinsic current magnetic field and by the solenoid magnetic field and is shaped as piston.

The generated jet impinges into the reactor chamber, where the material is sputtered off the electrode surface, and nanosized particles are formed.

Experimentation

Table 1. Experimental conditions for the synthesis of ultrafine copper oxide powder with coaxial magneto-plazma accelerator.

plasma	Cu
Medium	Air
Charging voltage	3kV
capacity	12 mF
electrode	Steel + copper tip

Output evaluation

Following the experiment X-ray microscopy of the obtained ultrafine powders was made. Full-profile X-ray analysis PowderCell package and structural data base PDF 4 + were used.

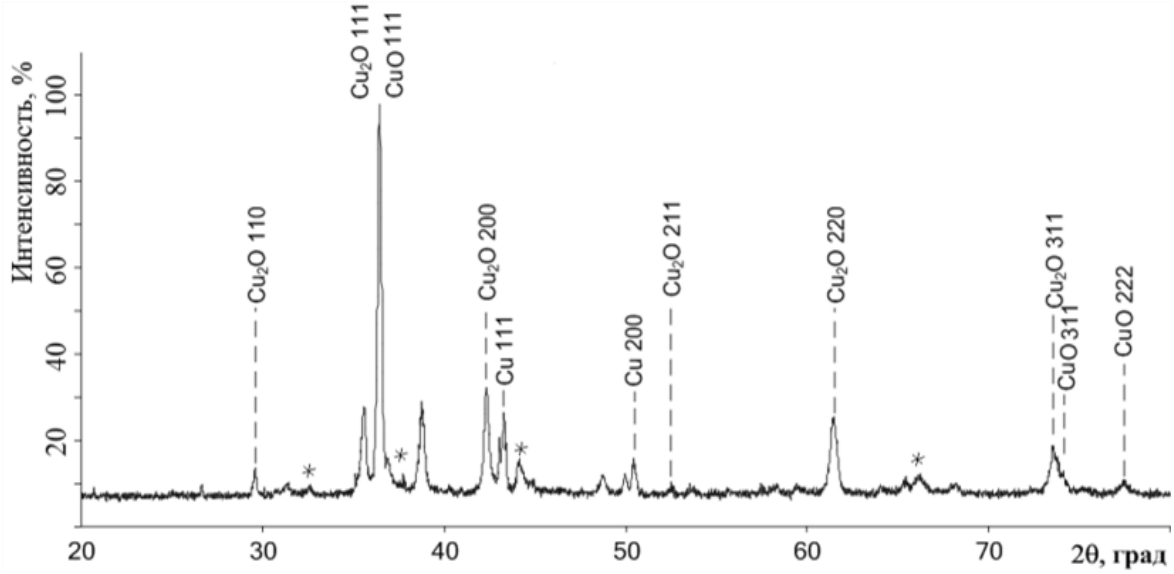


Figure 2. X-ray diffraction analysis.

The next synthesized powder phases were registered:.

- copper oxide (I) (Cu2O) – 3,5%.
- copper oxide (II) (CuO), exhibiting the highest rate(nearly 85%).
- pure copper (Cu) (nearly 8%).
- impurity phases, presented on radiographs as implicit peaks marked with an asterisk (*) – about 4%. Their presence in the synthesized powder could be explained by the fact that

the target material used in the experiment is aluminum. During the experiment erosion occurred when melting in the plasma jet. Therefore, aluminum oxide (Al_2O_3) is one of the fusion products.

Transmission electron microscopy data were also obtained and interpreted [7].

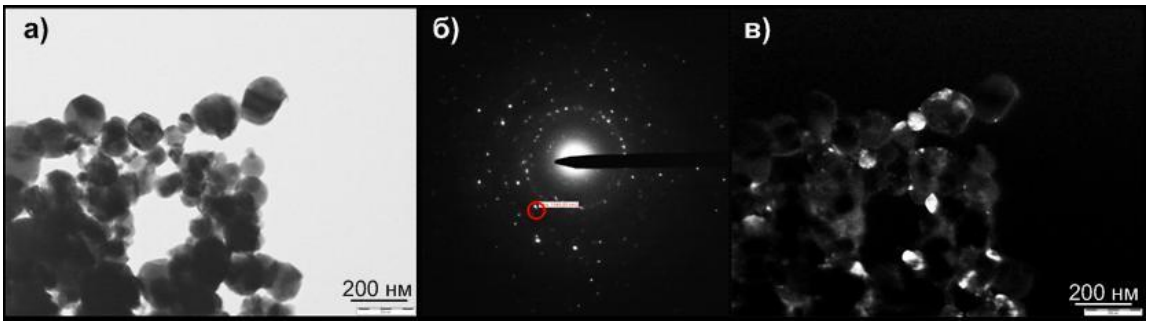


Figure 3. Transmission electron microscopy results: a) bright field image; b) electron diffraction pattern on the selected area; c) dark-field image.

Bright field image allowed identifying particle morphology. The particles form a convex polygon with rounded corners. Their size varies from 80 to 150 nm. Lighter, circular shaped particles are copper oxides. Darker, angular shaped ones are copper.

According to the electron diffraction pattern for the selected area it has been determined that the rubricated area is the crystallographic copper phase. Dark-field image was obtained when shifting the aperture diaphragm to the selected reflex point area representing crystallographic copper phase.

As the result of the study electron microscopy was interpreted. The composition of the nanopowder, obtained in laboratory conditions, was confirmed and its phases were defined.

Conclusion

The practical task is to obtain nanopowders with a small percentage of impurities and to increase the synthesis reproducibility. The method described meets these requirements. In future, we plan to obtain copper oxide using a coaxial magnetoplazma accelerato synthesize complex high-temperature superconducting materials.

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Circuitbreakers

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Abstract

Circuit Breaker a mechanical switching device designed to carry current in normal operation and protection of the equipment and wiring in the event of overload or short circuit.

In this essay refers to the main nodes of circuit breakers, classification, what kinds of releases are their design and operation.

Introduction

Circuit breakers are electrical switching devices designed to carry current circuit in normal mode and for the protection of electrical networks and equipment from the emergency operation (short circuit, overcurrent, and others), as well as for infrequent switching rated currents (6-30 times night).

Due to the simplicity, convenience, safety and reliability of service protection against short circuit currents, these devices are widely used in electrical installations of low and high power.

Circuit breakers are switching devices of manual control, but many types have a solenoid or motor drive, allowing you to control them from a distance.

Function and principle of operation

Machines are switched off usually by hand, and in violation of normal operation (the appearance of an overcurrent or undervoltage) – automatically. In addition, each machine is equipped with overcurrent release, and in some types of undervoltage.

By function protection circuit breakers are divided into the following types:

- overcurrent.
- undervoltage.
- reversepower.

Machines are used for overcurrent automatic disconnection of electric energyin case of short-circuits and as overload protection in an eventoccurring beyonda safe limit.

Classification

Circuit breakers are divided into:

- installation circuit breakers – they have a protective insulation (plastic) body and can be installed in public places ;
- universal – do not have this body and are designed for installation in switchgear;
- fast (own response time is less than 5 ms);
- low-speed (10 to 100 ms); from 10 to 100 milliseconds.
  Response is provided for rapid quenching of the electric arc.
- selective with adjustable response time in the area of short circuit currents ;
- automatic reverse current, triggered only in case of changing direction of the current in the protected circuit ;
- Polarized machines break a circuit only when the current rise occurs in the forward direction, unpolarized – in either direction of the current.

Design

Design features and operation of the machine are determined by its purpose and scope.

Turning on and off the machine can be done manually or by means of operating motorized electromagnetic drive.

Hand drive used at rated currents up to 1000 A and provides a guaranteed limit switching capacity regardless of speed including handle (the operator must perform switching operation manually).

Electromagnetic and electric motor drives are powered by voltage sources. Drive control circuit must be protected from reclosing on a short circuit, while the process of turning the machine to limit short-circuit currents must stop at a supply voltage of 85 – 110 % of nominal.

With overload and short-circuit currents circuit breaker is made regardless of whether the control lever is held in the closed position.

An important part of the machine is a release that controls the specified parameter of the protected circuit and affects the tripping device, which disables automatic. In addition, the release allows remote shutdown of the machine.

Basic components of the circuit breaker

- the contact system.
- arc system.
- releases.
- governance mechanism.
- trip-free mechanism.

Contact system consists of fixed contacts, fixed in the housing and a movable contact pivotally planted on a half- arm control mechanism and provides, usually, a single open circuit.

Interrupter device is installed at each pole of the breaker, and is intended to localize the electric arc to a limited extent.

Freewheel decoupling is articulated 3 – or 4 -pole mechanism that ensures tripping on and off as the contact system in both automatic and manual control.

Electromagnetic overcurrent release is an electromagnet with armature provides automatic circuit breaker at short circuit currents above the setpoint current. Magnetic trip device current with hydraulic slow response has inverse- time delay for overcurrent protection.

Maximum heat release is thermal bimetallic plate. At overload currents deformation and efforts of this plate provide automatic shutdown of the switch. Exposure time decreases with increasing current.

Semiconductor releases consist of a measuring element, the semiconductor relay unit and the output of electromagnet acting on a trip-free mechanism for the machine. As a measuring element the current transformer (on alternating current) or the throttle magnetic amplifier (on a direct current) is used.

Widespread releases of the following types

- electromagnetic protection against short-circuit currents ;
- thermal overload protection;
- combined;
- semiconductor having high stability and ease of operation parameters to configure.

For switching circuit without current or rare switching rated current machines can be used without releases.

Commercial series circuit breakers are designed for use in various climatic zones, placement in locations with various operating conditions, to work in an environment of different mechanical stress and explosion protection, and have varying degrees of shock protection from external influences.

Information on specific types of devices, their standard performance and sizes refer to the regulatory and technical documents. Typically, this document is technical specification (TS) of the plant. In some cases, in order to unify the products having wide application and manufactured at different plants, the document level increases (sometimes to the level of the State Standard).

Conclusion

In conclusion, I would like to say that the circuit breakers play a huge role in the electric power industry. This device is very important in our lives, so it protects the electrical network from short circuits and from various emergency conditions. Accidents can occur everywhere, such as in homes so industrial facilities.

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Wind power benefits

National Research Tomsk Polytechnic University

I've read in the Internet, that [1]"Canadian company Magenn Power tried the unusual type of the generator in the form of the revolving dirigible, which is able to get the wind from the big height. Flying wind-turbine is called MARS(Magenn Power Air Rotor System). Under the influence of the air stream its balloon revolves on its horizontal axis, to which generators are attached, and ropes, maintaining the dirigible at the one place and conveying the received electricity to the ground." I was interested, in what condition is the energetic problem nowadays and what is its solution. This is how the theme of my project "Wind power benefits" arose.

Practical part:

1) To make a calculation of the capacities of the ideal model of the wind-powered generator.
2) To make a calculation of the capacities of the ideal model of the wind-powered generator with all the losses.
3) To define the coefficient of the efficiency of the wind-powered generator and make a calculation of money saving depending on the number of windy days.
4) Make a conclusion about a rationality of the usage of the wind-powered generator.

There is a serious problem how to provide enough quantity of the electric power, fuel and raw materials. Fuel and energy resources constantly run out and in some hundreds years can totally disappear.

The principle part of energy, being consumed by mankind, we get from black coal, oil and gas, i.e. from materials which are called fossil fuel. This type of energy is called non-renewable energy because it cannot be used twice. Fossil fuel cause pollution of the environment, and, more than that, its reserves are limited. However, people's necessity in energy is so high that they continue to use this type of fuel.

In contrast to fossil fuel there are sources of renewable energy like water, wind, sun, inside warmth of the Earth. Although from the diagram we can see that only 4 % of the renewable energy is used, its reserves are unlimited.

Renewable energy causes less harm to the environment than non-renewable one, but nowadays it still cannot meet people's electricity demand. This type of energy is also called alternative energy, maybe because in the future the major part of our power inputs will fall to the share of alternative energy. In 2011 the total fixed capacities of all the wind-powered generators made up 237.227 megawatt.

[2 c.2]"International Energy Agency has worked out the scenarios of structural changing of the sources of raw materials' consuming for energy production to 2050.There are 2 of them: ACT Map (the first one), BLUE Map (the second one).

According to the first scenario of developing (ACT Map), the part of major types of the energetic raw materials (oil, black coal) in 2050 will reduce to the minimum, besides the altered gasified coal presents a considerable part – 15 %, the part of oil will reduce, the part of gas and casing-head gas increases. Renewable sources of energy can present 35% from the aggregate volume of electricity generation.

According to the second scenario of developing (BLUE Map), common energetic coal and oil will be out of use to 2050, the part of gas will diminish to 6-7 %, altered gasified coal makes up a considerable part – 15 % and nuclear power engineering – 24 %. Renewable energy sources can make up 46 % from the aggregate volume of the electricity generation.".

Wind as an energy source has been attracting mankind for a long time. Seeing what destructions can bring storms and hurricanes people started to think about the usage of the wind energy. For a lot of centuries people could use free and ecologically clean wind energy. Egyptians had been swimming under sail 2500 years before AD, using wind energy, filling sail of barks and ships.

The other example of the wind force usage are windmills. For ages people used the mechanical force of the wind, trying to facilitate their labour. Persians in VII century BC used this energy for field irrigation and grinding of grains. Not without reason people say: "Feeling the wind, a fool puts a shield from it, but a wise man puts a windmill. Windmills, generating electricity,were invented in 19 century in Denmark. In 1890 the first wind power station was built there, and to 1908 there were 72 stations with capacities fom 5 to 25 kilowatt. The biggest of them had the height of the tower of 24 metres and 4-fanned rotors over 23 metres in diameter.

«We make money from the wind!» – says one of the German companies producing wind powr stations. And this is especially true, because wind turbines generate energy from the air, and the energy is money, and not small at that.

I understand that we live in such a zone where the usage of such type of energy is not very reasonable, but is possible on a small scale. For example, you can try to use it on a garden plot.

[3]"In Russia at the beginning of the XXth century N. E. Jukovskiy worked out a theory of the wind engine. In Germany at the same time with Jukovskiy in 1919 the physicist Albert Betz discovered a law which defines the maximal energy, which could be got from the wind-powered generator. According to this law, a wind-powered generator can generate more than 59,3 % of kinetic energy of the wind.

The law of Betz means that wind turbine will never have bigger coefficient of efficiency than 59,3 %. This law can be explained considering that if all the energy, being received from the motion of the wind in turbine was transformed into useful energy, than the speed of

the wind will consequently be equal to zero. But if the wind stopped on going out of the turbine, than the fresh wind won't get into turbine – the turbine would be blocked. For the wind to continue its movement through turbine and to generate energy, some movement in the turbine itself is needed. I.e. there should be some limit of the efficiency of the wind turbine – Betz law, which is equal to 59,3 %.".

Wind-powered installation is a device for the transforming of kinetic energy into other types of energy. The particular thing would be a wind-powered generator which transforms kinetic energy of the wind into electricity.

The calculation of the capacities for the model of the wind-powered installation

$P = \frac{\varrho s v^3}{2}$ – deduced formula from the formula: $E = \frac{mv^2}{2}$ и $P = \frac{E}{t}$.

$S = \pi * R^2$ – rotor-swept area (m2).

ϱ- air density (1,29 kg/m3);

v-defined experimentaly: $v = \frac{s}{t}$ =0,6м/с.

Representing all the calculations we get $P = 6 * 10^{-4}$W.

[4]"The calculation of the capacities generated by the ful-size wind-powered generator.

On the basis of this data I made a calculation of the capacities generated by the wind-powered installation in the ideal conditions.

Calculation formula:

$Pu. = 0.5 * Q * S * V^3$.

P – capacities (watt);

Q – air density (1,29 kg/m3);

S – rotor-swept area (m2);

V – airspeed (mps).

Rotor-swept area for the 4-wing wind wheel I've found with the formula:

$S = L * h * n$.

S – rotor-swept area (m2).

h – height of the one cavity (m).

n – the number of cavities.

. $L = \pi R \quad L = 3.14m$

· $S = 3.14 * 2 * 4 = 25.12m^2$

· $Pu. = 0.5 * 1.29 * 25.12 * 4^3 = 1037W$

As 100% transforming of one type of energy into another is impossible, than we should exclude losses. Wind wheel has certain CPU usage of the wind energy. The maximal significance of theoretical usage of wind energy belongs to ideal high-speed vaned wind wheels and is equal to 0,593.For the best examples of high-speed wind wheels with aerodynamical profile this index is equal to 0,42-0,46. For multiblade low-speed wind wheels this index is fluctuating from 0,27 to 0,35 depending on the quality of carrying out and is marked with the symbol Cp in calculations. For the reconciling of the turns of low-speed wind wheel and generator it is necessary to use a speeder. The coefficient of efficiency of the speeder fluctuates from 0,7 to 0,9 depending on the coefficient of transferring and carrying out. Transforming mechanical energy into electrical one we also have losses.That's why we express it in the coefficient of efficiency of the generator Ng from 0,6 (for motor and tractor genera-

tors with an energizing coil) to 0,8 (for the generators with driving from permanent magnets).

$P = 0.5 * Q * S * V^3 * Cp * Ng * Nb.$

P – capacities (watt).
Q – air density (1,29 kg/m3);
S – rotor-swept area (m2);
V – airspeed (mps);
CP – the coefficient of the using of the wind energy (0,35);
Ng – the coefficient of the efficiency of the generator (0,8);
Nb – the coefficient of the efficiency of the speeder (0,9).".

$$P = 0.5 * 1.29 * 25.12 * 4^3 * 0.35 * 0.8 * 0.9 = 261W \approx 0.261kW$$

The calculation of the coefficient of efficiency for the full-sized wind-powered generator

$\eta = \frac{P}{P_{и.}}$ –the formula of the calculation of the coefficient of efficiency for the full-sized wind-powered generator.

P-capacity with all mechanical losses.

Pu-the capacity generated by the common wind-powered generator in the ideal conditions.

$\eta = \frac{261}{1037} = 0{,}25 = 25\%$ – the coefficient of efficiency of the wind-powered generator including all the losses.

The low index of the coefficient of efficiency can be increased if to use a wind-powered generator with high tower and long blades to increase the swept area.

[5]"Depending on the number of windy days a year and wind speed 3, 8 mps the capacity of the wind-powered generator:

181 days. $P = 2815kW * h$
275 days. $P = 4277kW * h$

In conclusion I want to say, that if consumed capacity is less than the one which is generated by the cheapest installation, than the installation of the generator won't be very expensive, and what is more, its cover of expenditure will go much faster. The lifespan of the generator is 20 years, also the service of the installation is required. Reasonable usage of the wind-powered generator is possible in the plant or in the area where there are no power lines."

In my situation it is necessary to acquire a wind-powered installation costing 3000 $ to get enough generated capacity. Its cover of expenditure will take 10-15 years.. Also it is absolutely unprofitable to buy a wind-powered generator if near there are power lines.

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Solar Energy in Russia

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"Shine always,. to Shine – and no nails!.
shining everywhere. The motto of my sun!".
until the last days before the end,. (Vladimir Mayakovsky).

Many poems of Vladimir Mayakovsky are famous for the amazing metaphors. The author managed to create a more figurative works only with this simple reception. For example, in the work "an Extraordinary adventure that was Vladimir Mayakovsky summer at the dacha ", which was written by the poet in the summer of 1920, the main character is the sun that the poet embodied as a living being. The author thought that the sun, every day travelling through the sky by one and the same route, is a slacker who simply have nothing to do.

In fact, moving away from literary epic, the Sun is the primary and main energy source for our planet. It warms the whole Earth, drives the river and gives the power to the wind. About 60 years ago for the first time the energy of solar radiation was converted into electricity by using semiconductor photovoltaic cells, which later received the name of solar cells (cells or solar).

The solar cell industry is rapidly developing in different directions: from built-in calculators to big panels on the roofs of cars and buildings. Currently there are increasingly large solar photovoltaic systems operating on highly concentrated solar radiation as an energy to actuate the thermal and other equipment (steam, gas turbine, thermoelectric and others).

The photoelectric effect

Energy conversion in photovoltaic converters is based on the photoelectric effect. Simply photoelectric effect is ejection of electrons from an emitting light substance. The first solar cell based on external photoelectric effect was produced by Alexander Stoletov. In 1888 he managed not only to get the photoelectric effect, but also to explain its origin. Photoelectric effect is the emission of electrons substance (usually metal) under the action of electromagnetic radiation.

The practical application in Russia

Certainly almost everyone has calculators that run on solar cells, they don't need electric batteries. As long as there is sufficient lighting, they can work for a very long time. Here are the most basic and obvious example of application of solar energy. Of course there are larger solar panels – on road signs indicating emergency telephone numbers, even at stops, as the source of light. Although these panels are not as widespread as calculators on solar energy, it is easy to see them.

Roughly, 10 companies in Russia are involved in production of solar collectors that are used to produce heat. The Ministry of Fuel and Energy estimated the total area of all solar collectors in 1994 as 100,000 m^2. In most cases, these installations work in the south of the country and only during the warm seasons of the year. Beside the commercial solar collectors, it is a common practice in the countryside of Russia to use showers that use water heated by the sun. Even the use of these primitive devices throughout the country eliminates the need to burn millions of tons of coal, oil, and gas to heat water.

For example, in the eve of the winter Olympics in Sochi it was decided to install solar modules on the Olympic venues: large ice arena, railway station "Olympic Park" and other.

In the end, the radiant energy of the Sun is used by the biosphere since the emergence of life on the planet. It is known that in just one second the sun produces so much energy that it

will last for 500 000 years on Earth. In fact the Earth gets enough light to provide the world with electricity for years to come in one hour.

However, solar power is one of the most material-intensive forms of energy production. The large-scale use of solar energy, also getting photovoltaic cells, entails a huge increase in the demand for materials, labour resources, raw materials extraction, enrichment, materials and so on.

Yet electric energy, born by sunlight, is much more expensive than obtained by conventional methods. However scientists don't stop and we hope that the experiments conducted in pilot plants and stations, will help to solve not only technical, but also economic problems.

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Future nowadays

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In everyday life we don’t think about the future, but the future is now. How our world looked like twenty years ago? Only some people had mobile phones with monochrome screens, there was a tiny heavy TV without high-speed internet, YouTube and google. Now can you imagine what will happen in the next twenty years? Technologies are moving faster than we imagine.

One of the modern technologies that have changed the computer world greatly is virtual reality. Virtual reality can be characterized by two main devices – Oculus Rift and OMNI. Oculus Rift is a new virtual reality (VR) headset designed specifically for video games that will change the way you think about gaming forever. With an incredibly wide field of view, high resolution display, and ultra-low latency head tracking, the Rift provides a truly immersive experience that allows you to step inside your favorite game and explore new worlds like never before.

The Oculus Rift creates a stereoscopic 3D view with excellent depth, scale, and parallax. Unlike 3D on television or in a movie, this is achieved by presenting unique and parallel images for each eye. This is the same way your eyes perceive images in the real world, creating a much more natural and comfortable experience. The Oculus Rift provides an approximately 100° field of view, stretching the virtual world beyond your peripheral vision. Your view of the game is no longer boxed in on a screen and is only limited by what your eyes

can see. The combination of the wide field of view with head-tracking and stereoscopic 3D creates an immersive virtual reality experience [1].

Moreover, there is another development even more impressive than the previous one. It is the game controller OMNI. The Omni enables you to move naturally and freely in virtual worlds. The release of affordable head mounted displays and low-cost sensor technologies has brought the decades-old dream of true virtual reality closer than ever [2]. The Omni takes virtual reality to the next level – allowing anyone to stand up and traverse virtual worlds with the natural use of their own feet. The Omni is the first virtual reality interface for moving freely and naturally in your favorite game. Moving naturally in virtual reality creates an unprecedented sense of immersion that cannot be experienced sitting down.

Human augmentation is believed to be another modern technology that made a great contribution to the people's lives. It is generally used to refer to technologies that enhance human productivity or capability, or that somehow add to the human body. Modern advancements in many areas of IT have led to a greater variety of implants and other technologies that could be classed as human augmentation. Within the greater category of human augmentation technologies, some different classifications can be made. For example, there are devices and implants that contribute to more advanced sensory devices, such as cochlear implants. Then there are orthotics or limb devices that can enhance motion or muscle capability. Other types of human augmentation may work with specific sorts of IT resources, such as big data assets. Some tech companies are rumored to be working on these kinds of data-connecting devices that would link the human body up to outside sources of information, either visual or text-based, or both.

While many of the new options for human augmentation seem to be empowering and offering improvements to human health and quality of life, part of the scientific community has expressed concern about human augmentation tools built on powerful tech concepts like biotech and nanotechnology, which must be closely observed for safety and long-term potential ramifications [3].

Military organizations are now experimenting with a wide range of 1st generation human augmentation technologies, including exoskeletons that allow personnel to carry increased loads and perform at a higher level. These devices have the potential to be adapted for use in healthcare and many other industries. Elderly people could benefit from powered human augmentation technology, such as powered exoskeletons, that can be used to assist wearers with simple walking and lifting activities, improving the health and quality of life for aging populations.

New implantable brain-machine interfaces have been developed and are being tested that are demonstrating that directly bridging the gap between brain and prosthetics devices are becoming a reality – allowing prosthetic devices to be directly integrated with the user's body. Neuro-enhancement technology under development could also provide superior memory recall or speed of thought for humans. Think of the possibilities for the those suffering from some form of dementia.

Human augmentation technology will probably not begin to be widely available for at least 10-15 years. However, as the field continues to advance, some people may eventually choose to enhance their bodies, much as they do with cosmetic surgery today. The high cost of human augmentation technology may lead to the emergence of a two-tiered society of enhanced and non-enhanced people [4].

People get used to observe cyber-implants in sci-fi movies, but they exist now. Different parts of the body can be replaced with cyber implants nowadays. Embedding a chip in the head help you control a cyber-hand. Cyber-legs with lots of motors and sensors can com-

pletely copy the movement of your foot. Cyber-eyes have not been very developed yet, however they are likely to be used in near future.

One more great achievement of nowadays is robots. Robots have replaced humans in the assistance of performing those repetitive and dangerous tasks which humans prefer not to do, or are unable to do due to size limitations, or even those such as in outer space or at the bottom of the sea where humans could not survive the extreme environments. There are concerns about the increasing use of robots and their role in society. Robots are blamed for rising unemployment as they replace workers in some functions. The use of robots in military combat raises ethical concerns. The possibilities of robot autonomy and potential repercussions have been addressed in fiction and may be a realistic concern in the future.

Robotics is the branch of technology that deals with the design, construction, operation, and application of robots, as well as computer systems for their control, sensory feedback, and information processing. These technologies deal with automated machines that can take the place of humans in dangerous environments or manufacturing processes, or resemble humans in appearance, behavior, and/or cognition. Many of today's robots are inspired by nature contributing to the field of bio-inspired robotics [5]. Today, robotics is a rapidly growing field, as technological advances continue; research, design, and building new robots serve various practical purposes, whether domestically, commercially, or militarily. Many robots do jobs that are hazardous to people such as defusing bombs, mines and exploring shipwrecks.

Furthermore, there are humanoid robots which can walk on uneven surfaces, climb stairs, talk, help with housework and do what men can’t do. A humanoid robot is a robot with its body shape built to resemble that of the human body. A humanoid design might be for functional purposes, such as interacting with human tools and environments, for experimental purposes, such as the study of bipedal locomotion, or for other purposes. In general, humanoid robots have a torso, a head, two arms, and two legs; though some forms of humanoid robots may model only part of the body, for example, from the waist up. Some humanoid robots may also have heads designed to replicate human facial features such as eyes and mouths. Androids are humanoid robots built to aesthetically resemble humans. Humanoid robots are used as a research tool in several scientific areas. Researchers need to understand the human body structure and behavior (biomechanics) to build and study humanoid robots [6].

Human cognition is a field of study which is focused on how humans learn from sensory information in order to acquire perceptual and motor skills. This knowledge is used to develop computational models of human behavior and it has been improving over time.

In conclusion it is necessary to mention that technology represents man’s attempt to make life easier due to the fact that technological advances improve people’s standard of living.

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System Operator of the United Power System

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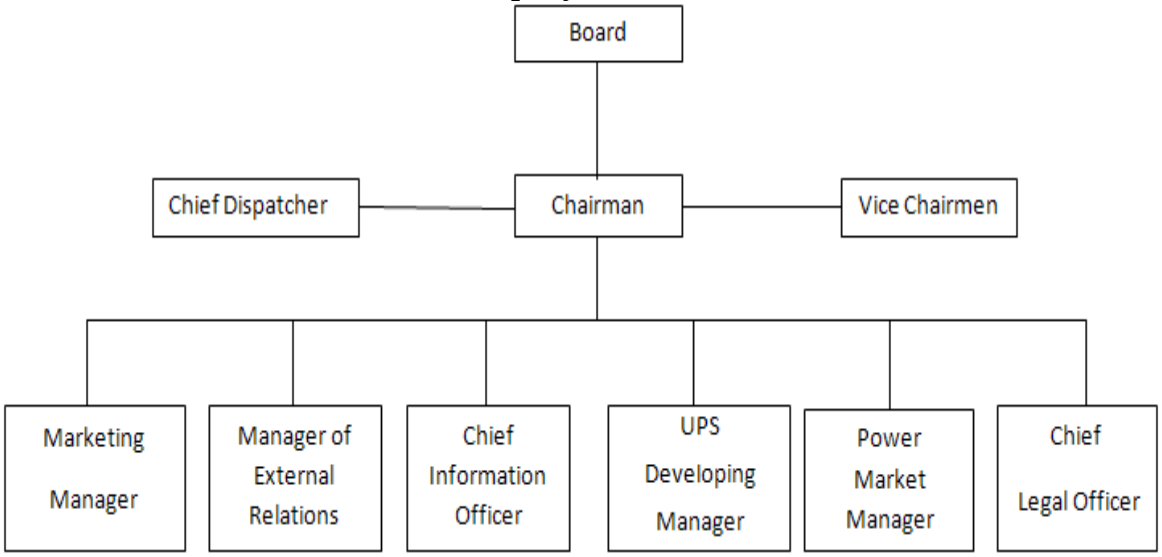
Introduction

The open joint-stock company System Operator of the United Power System is a specialized organization that single-handedly performs centralized control of the Unired Power System of Russia and provides electricity dispatching services and operates a high voltage electricity transmission grid.

Company history

Before 2002 energy control system consisted of Central Dispatch Office, 7 unified dispatching offices and regional dispatching offices. In 2002 a new administrative organization was established-System operator- Central Dispatch Office of United Power System which got functions of managing of the United Power System. In 2008 company changed its name to System operator of the United Power System. Nowadays the company is based in Moscow and has a work force of more than 8000 empoyees.

Company Structure



The head of the company is the Chief Executive Officer.He is pesponsible to Board of Directors.Board of Directors is first of all responsible for ensuring that energy meets all its financial and legal obligations.

Managers of varios departments which are are vital to a company report directly to the CEO.These managers may be referred to as the management team.They are required to

advice the CEO on consequences of any decision in terms of costs,time,personnel e.t.c.For example:

Chief Information Officer is responsible for leading and overseeing the development, implementation and operation of information systems and information technology policy.Chief Dispatcher is responsible for the operation of the Electricity Management System used to monitor and control the electricity generation and is responsible for monitoring systems that provide real-time information on electricity transmission system.

All departments are interdependent. There are regular meeting to develop long-term energy strategies and plans.

Corporate Culture

One of the main aims of the company is to provide people challenging and rewarding work in a pleasant environment. Firstly, corporate culture includes formal dress style. Additionally everyone should follow certain rules:

-pay attention to expected norms of behavior.

-build and maintain positive working relationships.

-maintain a positive attitude.

-value constructive criticism.

Work behavior should include: cooperation, showing respect for others, professional communication.

Also corporate culture includes company's own trademark and anthem. In addition to this there are regular classes and courses for professional and personal development of staff.

Company Activities

System Operator of the United Power System is a specialized organization which provides centralized operative and dispatching control of technological mode of the United Power System of Russia (UPS of Russia).

Besides, the System Operator controls the synchronous operation of UPS of Russia with power systems of 12 foreign states: Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Mongolia, Latvia, Lithuania, Uzbekistan, Ukraine, and Estonia. In the course of the activity the System Operator carries out 3 main groups of tasks:

- ensuring reliable operation of UPS of Russia in real time.

- ensuring perspective reliability of UPS of Russia.

- ensuring technological unity and effective work of the wholesale and retail markets of electricity and capacity.

Performing the tasks assigned to it, the System Operator carries out the following main functions:

- exercises the centralized operative and dispatching control of electric mode of UPS of Russia in real time.

- carries out short-term, medium-term and long-term planning of electric modes for UPS of Russia.

- provides functioning and development of automatic systems of relay protection and emergency control automatic systems.

- participates in development and implementation of development programs of UPS of Russia, the interconnected and regional power systems.

- participates in control of technical condition of the power entities influencing reliability and security of UPS of Russia operation, and also in investigation of technological disturbances.

- carries out control of timely and appropriate implementation of investment programs of the generating companies created by the results of the capacity trade.

- carries out technological and administrative support of trading procedures, participates in development of technologies of the markets of electricity and capacity.

Conclusion

Company System Operator of the United Power System as many other companies has its own success strategy. The main reasons of their success are independence and objectivity.

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Wo Wasser fliesst, fliesst Strom

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Abstract: Im Artikel wurden aktuelle Fragen und Forschungstrends auf dem Gebiet der Wasserkraft untersucht. Die Anlagen und Generatoren sind dargestellt, die den Energiefluss in Strom umwandeln. Die Prognose ist für die Entwicklung der Wasserkraft in Deutschland und Russland angeführt. Daten sind über die Kosten für 1 kW pro Stunde für traditionelle und alternative Anlagen aktualisiert.

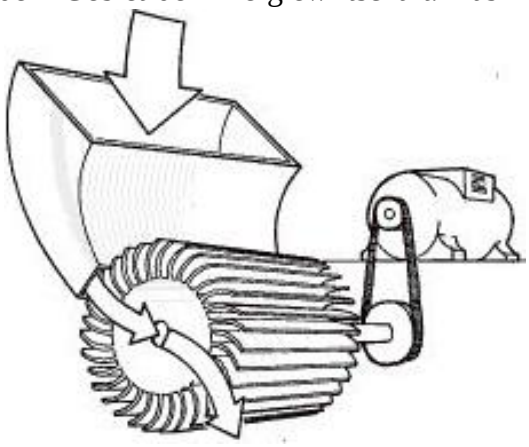
Schlüsselwörter: Wasserkraftanlage, alternative Energie, Generator, Wellengenerator.

Die Aktualität dieses Artikels besteht darin, die komplexe Analyse der Parameter der Anlagen bei der Umwandlung der Wasserkraft in Strom zu zeigen und die Daten über die Nutzung der Wasserenergie in verschiedenen Ländern anzuführen.

Das Ziel des Artikels wird durch die Notwendigkeit der Betrachtung der Wasserenergie in Deutschland, Russland und Österreich bedingt.

Die Objekte der Forschung im Artikel sind traditionelle und alternative Anlagen in den europäischen Ländern.

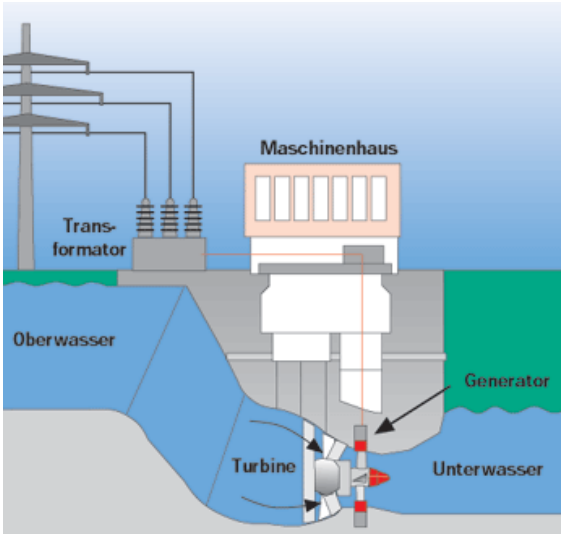
Die Wasserenergie ist heute die aussichtsreichste der erneuerbaren Energiequellen auf dem Gebiet der Energiewirtschaft. Das Potential dieser Energie ist in der Welt riesig, deshalb haben die Wissenschaftler die verschiedenen Anlagen zur Umwandlung der Wasserkraft in Strom erfunden. Es gibt eine große Zahl der Anlagen, aber sie werden nach dem gleichen Prinzip betrieben.



In der deutschen wissenschaftlichen Zeitschrift „Wassertriebwerk“ wird ein Artikel angeführt, in dem steht: „Die Energie einer Wasserströmung kann Arbeit verrichten. Dies wird in Wasserkraftwerken genutzt: Die Strömungsenergie treibt dort über ein Turbinenrad Generatoren an, die Strom erzeugen (Abb.1).

Abb. 1: Das Konstruktionsprinzip einer Wasserturbine.

Dabei werden hohe elektrische Wirkungsgrade von über 90 Prozent erreicht. Die erzeugte Strommenge hängt in erster Linie von der Menge des fließenden Wassers und der Höhendifferenz ab. In Deutschland sind Lauf-, sowie Speicher- und Pumpspeicherkraftwerke die vorherrschenden Kraftwerkstypen“.



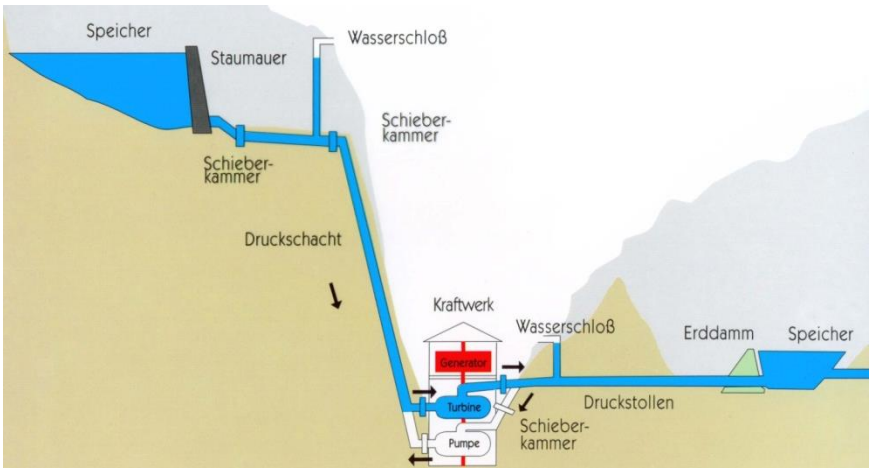
In Deutschland entfällt der weitaus größte Teil der Wasserkrafterzeugung auf Laufwasserkraftwerke. Bei diesen ist eine Steuerung des Wasserdurchflusses in Abhängigkeit vom Elektrizitätsbedarf meist nicht möglich. Sie werden deshalb in der Regel rund um die Uhr kontinuierlich betrieben und geben ihren Strom zur Deckung der Grundlast ans Netz der öffentlichen Versorgung ab.

In Laufwasserkraftwerken werden aufgrund des geringen Gefälles meistens Kaplanturbinen eingesetzt.

Abb. 2: Das grundsätzliche Schema einer Laufwasserkraftwerke.

Bei Speicherwasser-Kraftwerken wird das Wasser zum Beispiel durch eine Talsperre, die einen Bach oder Fluss aufstaut, in einem hoch gelegenen See gespeichert und von dort über Druckrohrleitungen oder Druckstollen den Turbinen des niedriger gelegenen Kraftwerks zugeführt. Vor der Druckrohr-Fallleitung wird ein Ausgleichsbehälter (“Wasserschloss”) gebaut. In Speicherkraftwerken finden je nach Fallhöhe Francisturbinen oder Peltonturbinen ihre Einsatzgebiete.

Speicherwasser-Kraftwerke sind in der Regel nicht für den Dauerbetrieb gedacht, da sonst ihre Speicherbecken bald leer wären. Ihr Sinn besteht vielmehr darin, das in Wochen, Monaten und im jahreszeitlichen Wechsel unterschiedlich anfallende Wasser zu speichern und bei erhöhtem Strombedarf zur Vertagung zu stellen. Man nennt sie deshalb auch “Spitzenleistungs-Kraftwerke”.



Die Speicherwasser-Kraftwerke dienen vielfach gleichzeitig auch anderen Zwecken, etwa dem Hochwasserschutz, der Trinkwasserspeicherung, Bewässerungszwecken oder Bedürfnissen der Schifffahrt.

Abb. 3: Das grundsätzliche Schema einer Pumpspeicherkraft.

Bei Pumpspeicher-Kraftwerken wird das hochgelegene Speicherbecken meist nicht durch einen natürlichen, kontinuierlichen Zufluss gefüllt. Wo es solche natürlichen Zuflüsse gibt, haben sie in der Regel nur ergänzende Funktion. Das Wasser kommt vielmehr ganz oder zum überwiegenden Teil aus einem tiefer liegenden Becken und wird mit elektrischer Energie hochgepumpt.

Das mag auf den ersten Blick widersinnig erscheinen, da die für das Hochpumpen erforderliche Energiemenge zwangsläufig größer sein muss als die elektrische Energie, die mit dem hochgepumpten Wasser hinterher erzeugt werden kann. Technisch und betriebswirtschaftlich macht diese zweimalige Energieumwandlung von elektrischem Strom in potentielle Energie und zurück aber dennoch Sinn: Sie ermöglicht es, in Zeiten geringen Strombedarfs die nicht ausgelasteten Kapazitäten der Grundlastversorgung für das Hochpumpen des Wassers zu verwenden. Wenn dann Bedarfsspitzen auftreten, werden die Turbinen eingeschaltet und verwandeln die potentielle Energie des hochgepumpten Wassers wieder in Strom. Auch finanziell lohnt sich die Sache, da auf diese Weise z.B. billiger Nachtstrom zu teurem Tagstrom verwandelt werden kann.

In der Praxis erreichen Pumpspeicher-Kraftwerke einen Wirkungsgrad von etwa 75 % (heißt: um 1 kWh zu erzeugen, müssen etwa 1,3 kWh aufgewendet werden), so dass also ein Viertel der aufgewendeten Energie verloren geht.

Inzwischen sind eine perspektivische Richtung im Aufbau der Wasserkraftwerke die Pumpspeicher-Kraftwerke, aber die Laufwasserkraftwerke sind die wirtschaftlichen Werke. In Russland werden die Speicherkraftwerke heute nur ausgenutzt. Alle in USSR gebauten Wasserkraftwerke werden bis jetzt betrieben und viele Wasserkraftwerke werden gebaut.

Die Wasserkraft ist eine günstige erneuerbare Quelle. Die Erzeugungskosten hängen jeweils von der Anlagengröße ab. Bei Wasserkraftwerken größerer Flüsse kann der Strom in Deutschland zu ca. 6,5 Cent / kWh, in Russland – 3,5 ÷ 4 Cent / kWh erzeugt werden (z.B., die Preise der Stromenergie der Wärmekraftwerke betragen 4,5 ÷ 9 cent / kWh).

Die Nachteile der Wasserkraftwerke. Wichtiger Nachteil der Wasserkraftwerke sind Eingriffe in die Natur und Gefährdung von Wasserlebewesen. Die Moskauer deutsche Zeitschrift schreibt folgende: „Der Bau von Staudämmen und großen Wasserkraftanlagen kann die Natur stark verändern und ganze Landschaften austrocknen. Das kann die Existenz sowohl von Tieren als auch von Menschen gefährden, die ihren Lebensraum oder ihre ökonomische Grundlage verlieren. Wenn der Lauf von Flüssen verändert und unterbrochen wird, sind auch Fischarten bedroht, die ihre Laichplätze nicht mehr erreichen können“ [2]. Trotz der sauberen Art der Energiegewinnung richten sich deshalb vor allem Naturschützer gegen einen weiteren Ausbau der Wasserkraft.

Die Wasserkraft ist heute eine sehr perspektivische Richtung auf dem Gebiet der Stromerzeugung, aber wesentliche Nachteile ermöglichen es kaum, diese Branche schnell zu entwickeln. Es sind neue Engineering-Lösungen notwendig, die den Eingriff in die Natur verringern werden. Deshalb wurden im vergangenen Jahr die Mindestvergütung für Strom aus Wasserkraft und die Zuschüsse für ökologische Verbesserungen angehoben. Gewässer- und Fischschutzmaßnahmen können künftig einfacher mit Modernisierungen an Wasserkraftanlagen kombiniert werden.

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Ilyina, A.Ye.

Transmission Capacity of Overhead Power Lines and Ways of their Improvement

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Due to the significant increase in the cost of building new high-voltage power lines, the role of increasing the capacity of existing and newly constructed overhead . Is economically advantageous to increase the transmit power through until limit heat through various devices.

The task of the article is to show what determines the capacity of the transmission line and in what ways it can be improved.

The urgency of the problem is obvious, because we live in a huge country, the power which is the largest in the world. It is therefore very important that the capacity of the transmission line was as much as energy is transmitted over long distances.

Just increasing the capacity – an important technical and economic challenge, as it eliminates the construction of additional transmission lines and provide the necessary power to the consumer . It is important not only to increase the capacity of constructed lines, but also to prevent accidental reduce it.

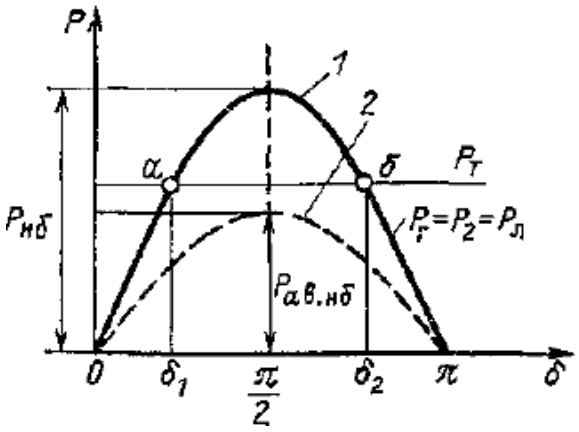


Figure 1 - The relationship between the transmit power of the angle δ.

The capacity of power lines

The capacity of power – this is the highest active power, which, taking into account all technical restrictions can be passed down the line. Technical constraints are defined : stable parallel operation of generators, heat transfer of individual elements, the value of long-term allowable voltage loss on the crown on the line, and other factors.

If you do not take into account the technical constraints, the bandwidth is equal to the MFN amplitude sine wave in Fig. 1: $P_{нб} = \frac{E_q U_2}{x_\Sigma}$

The greater the capacity of the power NLR, the more power can be transmitted over the line. But we can not allow an emergency reduce it. For example, if the result of an accident throughput drops to Rab.nb (see the dashed sinusoidal curve 2 in Fig. 1), then it would reduce the power transmitted on the line, and canceling the consumer. Mode corresponding to a stable point (Fig. 1), there is no reduction in the capacity to Rab.nb.

Measures to improve the capacity

Measures to improve the capacity of existing and newly built power include, inter alia, the effect on the EMF generator (Eq), the total resistance (hΣ) and the substation busbar voltage at the end of line (U2).

EMF generator Eq regulated current of the generator. In accidents it is important to maintain the excitation of the generator, ie prevent conditions RPB <pm, where it is necessary to reduce the transmit power through . In the Soviet Union for the first time in the world have developed a strong excitation controls the actions that kept constant during accidents not only the EMF generator Eq, but even on the tires of the generator voltage Ur (see Fig. 2). Regulators strong actions are widely used for high-power plants.

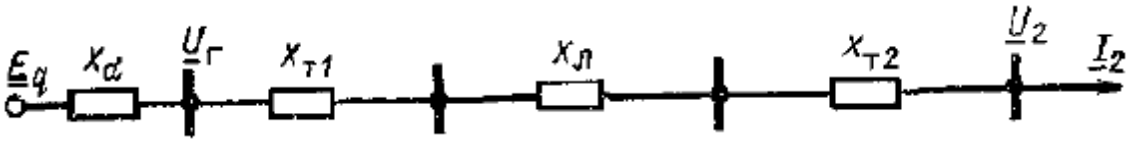
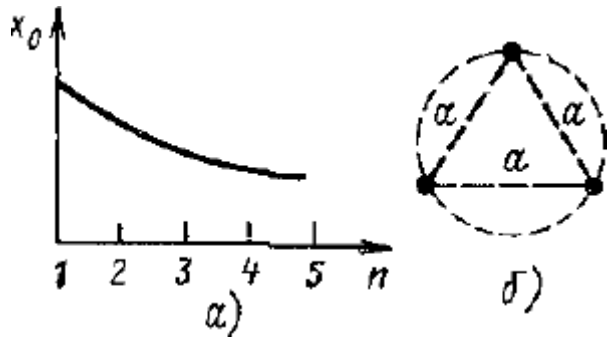


Figure 2 – Equivalent circuit of power.



The total resistance xΣ and its components appropriate to reduce it. Resistance generators and transformers is reduced by the use of special steels and special design solutions. The inductive reactance of lines of 330 kV and higher voltage lower by splitting phase – phase perform not one, but several parallel wires (Fig. 3).

Figure 3 – Cleavage of wires in phase: A – x0 decrease depending on the number of wires in the phase b, the location of phase conductors 500kV line.

In lines with Un = 330 kV cable splits into two, ie, n = 2, to 500 kV n = 3, wherein a = 40 cm.

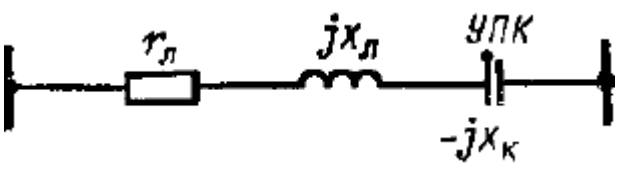


Figure 4 (left) – Longitudinal compensation lines.

Application of series compensation (Figure 4) is a viable and popular means of increasing the capacity of long-distance power lines. CPC capacitors connected in series in the line, reduces the resultant reactance line.

With a moderate amount of series compensation are limited to one of the CPC on the line. If the resistance of the capacitors of the CPC is that offset 50% or more resistance line, it is necessary to perform the CPC is not less than two substations. Focusing too much compensating resistance in one place leads to an increase in the multiplicity of internal overvoltage and causes difficulty in ensuring correct operation currently in use protective relays.

The voltage U2 on the buses at the end of the substation EHV line must be adjusted so that it is not reduced in the normal mode and the post-fault and that, in turn, reduces the capacity of the line. Effective use of managed devices shunt compensation: synchronous compensator (SC) and static reactive power compensators (Statkom).

FACTS technology

Next, consider the FACTS technology. In our country and abroad are working to create a managed (flexible) electrical connections, the load which can be set regardless of the load of any other links in the electrical network and controlled automatically or manually by a given law.

Devices based on the modern power electronics started to control the operation of power, able to simultaneously work on three of the above parameters (U, hΣ, δ), which improves efficiency and provides flexible control modes of power systems. Such technology abroad called FACTS (flexible alternating current transmission systems).

Function of FACTS:

- increasing the capacity of transmission lines;
- ensure stable operation of the power system under different perturbations ;

- ensuring a given (forced) power distribution in networks, in accordance with the requirements of the supervisor;
- Increased reliability of energy consumers;
- Reduction of losses in electric networks ;
- the task of turning the mains of a "passive" device transport electricity in the "active" control modes.

Wires high power and durability.

Currently, an increase in transmit power network requires a large investment. Since power consumption is growing, network companies have to reconstruct the existing network with increasing wire size, and thus increases its mass. Ultimately, companies are faced with the replacement of the existing power grid supports the new, designed for higher loads, or the construction of new transmission lines. The latter can be difficult especially when proleganiya VL in a densely populated area, and in sparsely populated areas of private land, such as national parks, nature reserves and other areas with a ban on construction. Thus, the recent attempts to develop a wire combine high mechanical strength and low weight without compromising throughput attracted the interest of various companies.

We consider a number of existing developments.

Aluminum Conductor Composite Core wire. Standard iron cores can overheat in peak electrical loads, which leads to stretching of the wire and below the permissible sag rate. In contrast, the core wire of the composites has a lower thermal expansion coefficient and are therefore less susceptible to thermal expansion than the steel core conductors. Replacing the wire with a steel core wire for composite materials can increase the capacity of the lines. Manufacturers wire say can double the amount of current in the line without the risk of sagging and wire fracture.

Properties of composite material – high strength to weight ratio and the low slack value, which leads to an increase in span between supports, reducing the number of poles in line at 16%.

ACCC cable system can operate continuously at 180^0C and can withstand short-term jumps up to 200^0C, with sagging only 10% of the slack cable with steel core.

Although the value of the product ACCC per km is about 3 times higher than conventional wires, the economic effect of their use ensures high return on investment.

Conductive Composite Reinforced Aluminum wire (Aluminum Conductor Composite Reinforced (ACCR)). Composite fiber core consists of high purity alumina ceramic. Each core consists of more than 25,000 heavy-duty fiber Al_2O_3. The cores have diameters from 1.9 mm to 2.9 mm. Ceramic fibers are continuous, axial orientation, and placed completely in the aluminum matrix. The wire is a standard twisted wire with a wrap consisting of a continuous strand Al-Zr. The outer strands of Al-Zr are heat-resistant alloy that can operate continuously at 210^0C, with peak loads up to 240^0C. Conductor composite core is about 9 times stronger than aluminum and is 3 times tougher. Core being half lighter than corresponding iron core has a higher electrical conductivity and has a coefficient of thermal expansion in the same half of the values for steel.

The use of composite-cored wires can not only increase the capacity of transmission lines and reduce the costs of reconstruction, but also due to the higher conductivity of the composite core to reduce electrical losses in overhead.

Wires, called Aero-Z ® (110 – 1150 kV) are fully interconnected conductors, which consist of one or several concentric layers of round wires (inner layers), and the wires in the form of the letter "Z" (outer layers) . Moreover, one or more conductors may be hollow and contain within the optical fiber. External layers of the same wires are made of aluminum

wire having a shape of the letter "Z", where the conductors are very closely adjacent to each other.

It is thus possible to use thinner and lighter wires. This in turn reduces the power losses in the conductors 10-15%, including the loss of the crown, and increasing the mechanical strength of the structure . Through tight twisting virtually eliminated penetration into the inner layers of water and impurities, thus decreasing corrosion of the inner layers of wires . Wire Aero-Z ®, having a higher torsional rigidity practically does not rotate, which leads to excessive snow self relief under the action of gravity.

Due to a more smooth outer conductor structure Aero-Z ® are about 30 – ¬ 35% minimal aerodynamic wind load resistance as compared with the conventional wire. This fact leads to a dramatic reduction conductor galloping.

GTACSR («Gapped» TAL alloy Aluminium Conductor Steel Reinforced) – is carried out with a gap made of aluminum alloy resistant to high temperaturam.Alyuminievye conductors of the inner layer closest to the core, and have a trapezoidal cross section. The inner layer is made in such a way that between them a gap iron core is filled with grease resistant to temperature. This design provides a sliding aluminum layers relative to the steel core, thereby GTACSR wire can be pulled, just fixing a steel core. This solution guarantees: the small sagging wires due to the increase in temperature. The maximum operating temperature is 150 GTACSR wires 0C. At this temperature, the transmit power can be increased by 2 times.

In the future, questions about transmission of electric power is still to be decided on the basis of overhead transmission lines, since they are much cheaper than cable, despite their serious shortcomings. Of course, the prospects for the use of ¬ overhead transmission lines will largely be determined by how much will be able to eliminate their shortcomings, improve performance and enhance the technical and economic performance.

At the same time, thanks to advances in modern power electronics there is an alternative that allows you to delay the strengthening of existing lines and new gasket . It is to improve the use of existing grid infrastructure by increasing its flexibility and manageability. This is possible by setting the transmission system managed by special devices called devices FACTS.

Currently considered international projects interconnection of the countries concerned, which will implement the most cost-effective electricity surpluses each member association, as well as to mutual assistance in emergency situations, such as in post-emergency conditions of individual power systems.

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Sonne als unerschöpfliche Energiequelle

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Abstract: Der Artikel handelt von der Nutzung der Solarkraft als aussichtsreicher Richtung der heutigen Energiewirtschaft. Er enthält ebenfalls Informationen über Entwicklung der Solarenergiewirtschaft in verschiedenen Ländern. Die Analyse der in Solaranlagen erzeugten Energie wird durchgeführt.

Schlüsselwörter: Solarkraft, Strom, Photovoltaik.

Die Aktualität dieses Artikels besteht darin, die Umwandlung der Solarkraft in den Strom zu zeigen und die Nutzung dieser Energie für Heizsysteme zu betrachten.

Das Objekt des gegenwärtigen Artikels ist eine Solaranlage und ihre Parameter für Stromerzeugung.

Der Umstieg auf erneuerbare Energien stockt.

"Solarenergie ist zum unentbehrlichen Bestandteil für eine erfolgreiche Energiewende geworden", erklärt Carsten König, Hauptgeschäftsführer des Bundesverbandes Solarwirtschaft.

Im Jahr 1954 beobachteten Wissenschaftler, dass an elektronischen Bauteilen aus dem Halbleiter-Werkstoff Silizium eine elektrische Spannung auftrat, sobald Licht darauf fiel.

Dieses als Photovoltaik (PV) bezeichnete Verfahren macht sich die Tatsache zu Nutze, dass Licht aus bestimmten Halbleiteroberflächen Elektronen herausschlägt, die sich dann im Material bewegen und als elektrischer Strom ableitbar sind.

Als Grundstoff für Solarzellen wird heutzutage fast immer Silizium verwendet.

Da das Energieangebot der Sonne regional und saisonbedingt schwankt, sind Zusatzeinrichtungen nötig, wenn man rund um die Uhr und übers ganze Jahr hinweg gleichmäßig Strom zur Verfügung haben will. Hierzu dienen beispielsweise Speicherbatterien.

Ein typisch kommerzielles Solarmodul hat einen Wirkungsgrad von 15% – in anderen Worten, ungefähr ein Sechstel der Sonne auf das Modul in Strom umgewandelt. Die Verbesserung der Solarmodulwirkungsgrade, während die Kosten pro Zelle halten ist ein wichtiges Ziel der PV-Industrie.

Derzeit existieren vier Typen von Solarmodulen:

- monokristalline Module.
- polykristalline Module.
- Dünnschichtmodule.
- CIGS-Module.

Bei der Auswahl der richtigen Modultypen sind vor allem der Preis und der Wirkungsgrad (Effizienz der Energieumwandlung) entscheidend. Weitere Faktoren sind die Lebensdauer und das Montage-Gewicht. Das Material, die Materialdicke und die Materialstruktur sind die wesentlichen Unterscheidungsmerkmale von Solarmodulen. Das gängige Herstellungsmaterial ist nach wie vor Silicium, das für die Produktion von Dickschichtmodulen und Dünnschichtmodulen verwendet wird. Dickschichtmodule wiederum unterteilen sich in monokristalline und polykristalline Module. Eine Alternative sind CIGS-Module, die mit einer Kombination verschiedener chemischer Stoffe produziert werden.

	Monokristallin	**Polykristallin**	**Dünnschicht**	**CIGS**
Wirkungsgrad	15-20 %	15-20 %	5-10 %	13-15 %
Wärmeverahlten	Mittlere Einschränkungen bei	Mittlere Einschränkungen	Geringe Einschränkungen	Geringe Einschränkungen

	Monokristallin	Polykristallin	Dünnschicht	CIGS
	hohen Temperaturen	bei hohen Temperaturen	bei hohen Temperaturen	bei hohen Temperaturen
Lichtverhalten	Mittlere Einschränkungen bei diffusem Licht	Mittlere Einschränkungen bei diffusem Licht	Geringe Einschränkungen bei diffusem Licht	Geringe Einschränkungen bei diffusem Licht
Lebensdauer	ca. 30 Jahre	ca. 30 Jahre	ca. 30 Jahre	k.A.
kg pro Modul	8-16 kg	15 kg	1-2 kg	1-2 kg
Kosten/Leistung	hoch/sehr hoch	mittel/hoch	gering/mittel	hoch/gering

Monokristalline Solarmodule erzielen den höchsten Wirkungsgrad. Polykristalline Module haben das ausgewogenste Preis-Leistungs-Verhältnis. Dünnschichtmodule sind leicht und günstig. Die Wahl der richtigen Solarmodule lässt sich nicht pauschalisieren und sollte stets individuell an die Gegebenheiten des Objekts angepasst werden. Faktoren wie die geografische Lage oder die Ausrichtung des Daches spielen eine Rolle.

Weltweit steigt die Zahl der installierten Photovoltaikanlagen deutlich an, es ist auch zukünftig mit einer starken Nachfrage zu rechnen. Insgesamt belief sich der Zubau der Photovoltaik im Jahr 2011 auf 27,7 Gigawatt. Der in Deutschland installierte Anteil ist mit 27 Prozent nach wie vor sehr hoch, vom ersten Platz in dieser Statistik wurde Deutschland jedoch erstmals von Italien verdrängt. Ein Drittel des gesamten Zubaus entfiel 2011 auf unsere südlichen Nachbarn. So sieht es zumindest die EPIA (European Photovoltaic Industry Association), andere Marktanalysten kommen zu abweichenden Ergebnissen und sehen Deutschland nach wie vor als größten Markt.

Im Jahr 2013 wies die Photovoltaik unter den erneuerbaren Energien erneut das größte Wachstum auf. Die erzeugte Strommenge stieg nach dem aktuellen Bericht der Arbeitsgemeinschaft Energiebilanzen um 14 Prozent, während die Windenergie um 5,4 Prozent zulegen konnte. Die Biomasse verzeichnete einen Zuwachs von etwa sechs Prozent.

Während die Preise fossiler Energien steigen, wird Solarstrom von Jahr zu Jahr rapide preiswerter. Einer der großen Vorteile der Solarenergie ist außerdem die dezentrale Erzeugung. Der Strom wird dort produziert, wo er gebraucht wird: auf den Dächern von Haushalten, Büros und Industriegebäuden.

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Perspektiven der Biomasse als erneuerbarer Energiequelle

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Abstract: In diesem Artikel sind der aktuelle Stand und Perspektiven in der Umwandlung der Bioenergie in Wärmeenergie in der Europäischen Union und in der Welt betrachtet. Die Entstehung der Branche der Biomasse und Hindernisse ihrer Entwicklung sind analysiert. Die Beispiele der Umwandlung in die Bioenergie von Bioanlage sind angeführt.

Schlüsselwörter: Biomasse, Technologie, EU, Bioanlage, Umwandlung.

Die Aktualität dieses Artikels besteht darin, die Nutzung erneuerbarer Energien in Deutschland zu beleuchten.

Das Ziel des Beitrags ist es, das Potenzial der Bioenergieträger und ihre Auswirkungen auf die Umwelt zu schildern.

Das Objekt ist eine Bioanlage, die Biomasse als Brennstoff benutzt.

Biomasse ist erneuerbares Material biologischen Ursprungs. Biomasse für Energie kommt aus der Landwirtschaft, Forstwirtschaft und aus Reststoffen. Das sind Abfälle. Biomasse besteht in fester, flüssiger oder gasförmiger Form. Aus Biomasse kann Energie in Form von Wärme, Kälte, Strom und Treibstoff als Biodiesel, Pflanzenölen gewonnen werden.

Der Weltmarkt für Biomassekraftwerke: Das Beispiel des Vereinigten Königreichs, der Tschechischen Republik und Deutschlands

In den nächsten Jahren wird der Markt für Biomassekraftwerke weltweit wachsen: auf 3.500 BMKW im Jahr 2020. Das entspricht einer Erhöhung auf 50 Prozent in 8 Jahren. 930 Projekte müssen die Biotechnologien auf dem Weltmarkt anwenden.

Aktuell sind weltweit 2.350 Biomassekraftwerke in Betrieb. Diese verfügen über eine Leistung von zusammen rund 37.000 Megawatt (MW). Asien und Europa, Brasilien und die USA sind die wichtigsten Märkte für Biomassekraftwerke.

Z.B. Die Stromerzeugung im Vereinigten Königreich basierte lange Zeit ausschließlich auf fossilen Energieträgern. Auch heute noch haben Kohle und Gas einen großen Anteil an der Stromerzeugung. Die Entwicklung erneuerbarer Energien wurde hingegen lange vernachlässigt. Das Vereinigte Königreich hat sich nach Kyoto-Protokoll zum Ausbau der erneuerbaren Energien verpflichtet.

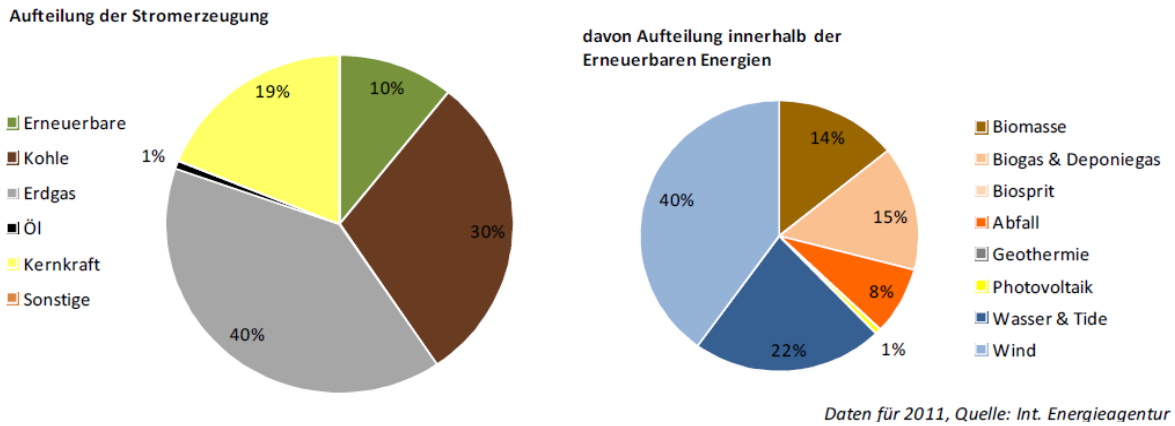

Abbildung 1:Aufteilung der Stromerzeugung im Vereinigten Königreich für 2011 [1].

In der Tschechischen Republik sind 12 stromerzeugende Biomassekraftwerke in Betrieb. In den letzten Jahren ist jährlich lediglich eine Anlage in Betrieb gegangen.

Tabelle 1: Aktuelle Energiepreise in Tschechien [1].

Biomasse	Vergütung (€ct/kWh)			
	Einspeisetarif	bis 100 kW	Grüner Bonus	
	2012	2013	2012	2013
O1 – Energiepflanzen	18,6	12,6	14,7	8,2
O2 – Restholz, nicht anderweitig verwendbar	14,3	7,8	10,4	3,3
O3 – Restholz, anderweitig verwendbar	10,7	3,0	6,7	0,0
S 1/2/3 – Mitverbrennung mit Kohle	-	-	5,5 / 2,8 / 0,04	5,5 / 2,8 / 0,04
P 1/2/3 – Parallelfeuerung mit Kohle	-	-	6,6 / 3,9 / 1,1	6,6 / 3,9 / 1,1

Bis Jahr 2050 soll sich der Primärenergiebedarf in Deutschland gegenüber dem Jahr 2008 halbieren. Energieholz aus dem Wald, Koppelprodukte und biogene Reststoffe würden die benötigte Energie liefern, und unnötige Biomassepotenziale können importiert werden.

Fläche unter den Pflanzen in Deutschland befindet sich in stofflicher und energetischer Nutzung. Am ersten Platz sind Raps für Biodiesel, Pflanzen für Biogas, Zucker und Stärke Bioethanol. Kleine Fläche benutzen Heil-, Färber-, Faserflanzen Stärke und Zucker Öl. Energiepflanzen dürfen bis 2050 4 Millionen Hektar (heute: 1,8 Mio. Hektar) wachsen.

Heute ist die Biomassevergasung bekannt. Das ist primäre Technologie, die brennbare Gase aus Biomasse produziert, z. B. aus Holz oder Energiepflanzen. Das Grundprinzip ist, die Biomasse bei erhöhter Temperatur (meist einige hundert Grad Celsius) unter Sauerstoffmangel umzusetzen. So werden nicht alle organischen Bestandteile unter Freisetzung von Wärme oxidiert, sondern es verbleibt ein wesentlicher Anteil brennbarer Substanzen wie Wasserstoff (H2), Methan (CH4) und Kohlenmonoxid (CO) im erzeugten Gas. Es handelt sich um eine Art von Synthesegas, welches entweder energetisch oder stofflich genutzt werden kann.

In Deutschland werden derzeit (Stand 2012) über 7.200 Biogasanlagen betrieben. Deren Stromerzeugung deckte 2011 etwa 2,7% des gesamten erneuerbaren Energiepotenzials.

Es gibt Vorteile der Nutzung von Biomasse zur Energieerzeugung. Biomasse schont knapper werdende fossile Brennstoffe; es wird weniger Kohlendioxid ausgestoßen. Biomasse trägt damit in erheblichem Maße zum Klimaschutz bei. Biomasse ist vielseitig und kann als fester, flüssiger oder gasförmiger Energieträger genutzt werden und Kraftstoffe ersetzen. Deutschland kann die Entwicklung ländlicher Flächen fördern und als Technologieanbieter stärken.

Doch Biomasse hat auch Nachteile. Der Anbau von Energiepflanzen auf begrenzten Flächen konkurriert mit der Nahrungsmittelproduktion und der Notwendigkeit des Schutzes natürlicher Ökosysteme. Das System führt zu höheren Emissionen an Treibhausgasen. In vielen Ländern sind Mais- und Weizenpreise gestiegen.

Heute setzt die Menschheit auf die Kaskadennutzung. Damit ist sie die vielseitigste aller alternativen Energieformen – und ihr Energieangebot ist nicht etwa von äußeren Einflüssen bedingt. Der erneuerbare Rohstoff hat den chemisch-technischen Energiezyklus gewonnen.

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Study of Cu-Al contact pair

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One of the main problems of energy that occurs when you connect the electrical connections is an electrochemical process that occurs during prolonged interaction of Cu and Al. The problem lies in the fact that aluminum is more active metal than copper[1]. Under normal conditions, the surface of aluminum products an layer of oxide, which deteriorates the conductive property. In this regard, an electrical contact becomes worse. The layer of oxide formed on the surface of copper products, does not affect the quality of the contact. The phenomenon of electrochemical incompatibility metal contact and therefore begins to warm up. If moisture gets begins the process of electrolysis, which destroys the contact and makes the connection to the potential fire hazard. Also, this terminal pair has a high value of the contact resistance of the transition, resulting in an increase in electricity losses.

Currently, there are several ways of combining the contact pair copper – aluminum. First, use of the bimetallic plate. Secondly, use of lubricants on the conductive contact of the copper powder. Thirdly, use of transition metal protective, abrasion-resistant coatings.

This paper proposes a new solution combining contact pair Cu-Al and reducing its transitional contact resistance by acting on the contact surface of the aluminum high-speed pulsed electrical discharge plasma jet generated copper coaxial magnetoplasma accelerator.

Conductive grease

Aluminum surfaces exposed to additional training before joining. Primarily made machining aluminum contact surface of sandpaper with an average grain size of the abrasive particles. Then sweep the surface of the layer of oxide . Due to the fact that the aluminum product in contact with air immediately covered with an layer of oxide, the cleaning of the surface layer produced by petroleum jelly, followed by coating the treated surface of the protective grease or paste, preventing oxidation of the metal.

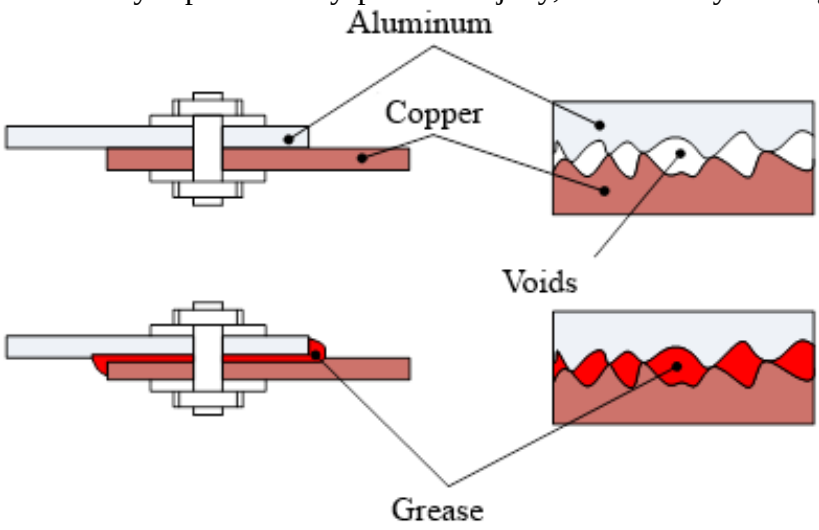


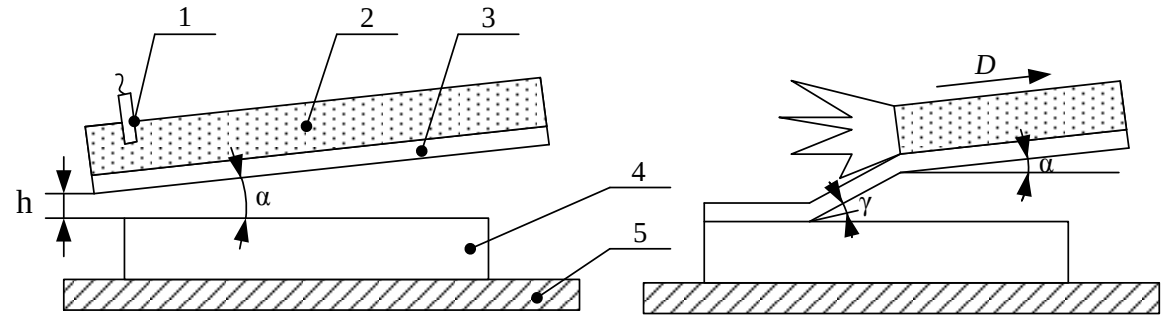
Figure 1 (left) – Principle of operation of conductive greases.

The use of conductive greases to reduce the transitional resistance in contact electrical contacts maintains their functional properties during thermal overloading (at a temperature up to 350-4000 °C). In addition, the conductive grease can provide corrosion protection of electrical contacts in an aggressive and humid environment. But as a result of prolonged cyclic loading conductive grease loses its properties and can not be reused as a result of the audit contacts[1].

Bimetallic Strip

Transient copper – aluminum gaskets are used for joining aluminum to copper conclusions tires electrical devices, as well as to the copper bars. Currently, more widely used in the production of composite materials technology has explosive welding.

Explosion Welding – is a welding method which uses the energy of the explosion. The part to be welded is located at an angle to the stationary target. As a result of the collision of parts of the explosion occurs metal jet stream, which spreads over the surface of parts, so that the plastic deformation occurs together the two parts and they are welded.



a) b).

Figure 2 – The angular diagram of explosion welding to the beginning (a) and the step of explosion (b): 1 – detonator 2 – explosive 3 – Metal plate 4 – the fixed plate 5 – Bearing.

Use of bimetallic plates allows combining a pair of contact Cu-Al, but the result is an increased number of contact junctions, which leads to a transient increase in the contact resistance and causes additional heating of the contacts, and additional power losses[3].

Protective coatings

Method of cold gas dynamic spraying

Method of cold gas dynamic spraying is used to restore the surface of products, strengthening and protection of metals against corrosion, improve thermal and electrical conductivity, etc.

Figure 3 (left)– Aluminum ferrules with copper plating.

In the gas dynamic technology applied to the substrate particles with a lower temperature, but having a very high speed (500 ... 1000 m / s).

Sputtering materials – polymers, carbides and metals – forming thermal barrier, wear and corrosion resistant coatings that can withstand the impact of chemically aggressive environments, high heat loads. As deposited (consumables) materials used fine and ultrafine powders with a particle size of 0.01-0.5 mm.

Advantages and disadvantages of gas-dynamic method.

- The coating is applied in an air atmosphere at normal pressure.
- In the area of coating product temperature does not exceed 100-150 °C. From this it follows that completely eliminated the occurrence of internal stresses in the products and their deformation, as well as oxidation of coating materials and components;
- The technology for environmentally safe coating.
- There is a cleaning of the surface from contamination due to the impact of technical high-speed flow of the spray particles.
- Feed the spray particles is highly directional and has a small cross-section.

The only disadvantage is the possibility of gas-dynamic spraying the coating only from relatively ductile metals such as copper, aluminum, zinc, nickel, etc.

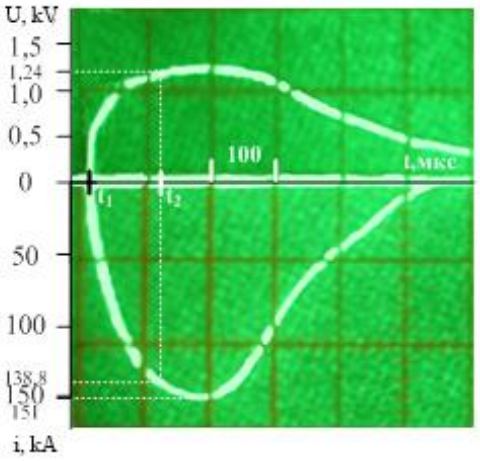
The operating principle of magneto coaxial accelerator

In the initial state coaxial magnetoplasma accelerator is included in the discharge circuit capacitive energy storage accumulator C charged to the required voltage U_z. With the clo-

sure of the key K at the time t_0, on the interelectrode gap voltage is equal to the charging voltage of the capacitive storage U_z.

In accordance with the laws of classical voltage maintains a constant level for some time. At time t1 occurs gap breakdown. In the circuit begins to flow operating current i(t). Breakdown delay time does not exceed 100 ÷ 150 ms. After the release of plasma from accelerating channel voltage starts gradually decline to nearly exponential law. At time t_2 the power consumption is stopped.

Plasma harness Z – pinch plasma and circular short-circuiting on the cylindrical surface of the accelerating channel, make the plasma structure, as the formation of which the discharge voltage is reduced to the level of the arc stage and going the speed limit upslope.



Steady state plasma structure is provided by the magnetic field pressure of its own current and magnetic field of the solenoid pressure axial external induction system.

Axial field of the solenoid and provides axial plasma acceleration due to compression of the plasma structure and axial displacement of the conducting medium.

Figure 4 (left) – Typical waveform current i (t) and voltage U (t).

During the operation of the accelerator in the discharge is continuously growing and is involved in over the mass of material accumulated by electro discharge from the surface of the accelerating channel. This material shall be made of jet acceleration channel and is the basis for the coating of the target – substrate positioned at some distance from the muzzle coaxial magnetoplasma accelerator.

Investigation of physical and mechanical properties of the coatings

Based on the terms of the research optimal energy parameters for copper plating are: capacitance of the capacitor bank C = 12 · 10-3 F, battery voltage U_z = 3 kV. Technological cycle is carried out under atmospheric conditionsP_0 = 1,0 atm. An energy storage capacitor W_c = 73.5 kJ, distance from the muzzle to the target of 180 – 420 mm. Under these conditions, one cycle is applied to the copper coating on an aluminum surface area of about 100 cm^2. The coating thickness is not less than 100 microns [2] The ring-shaped contact

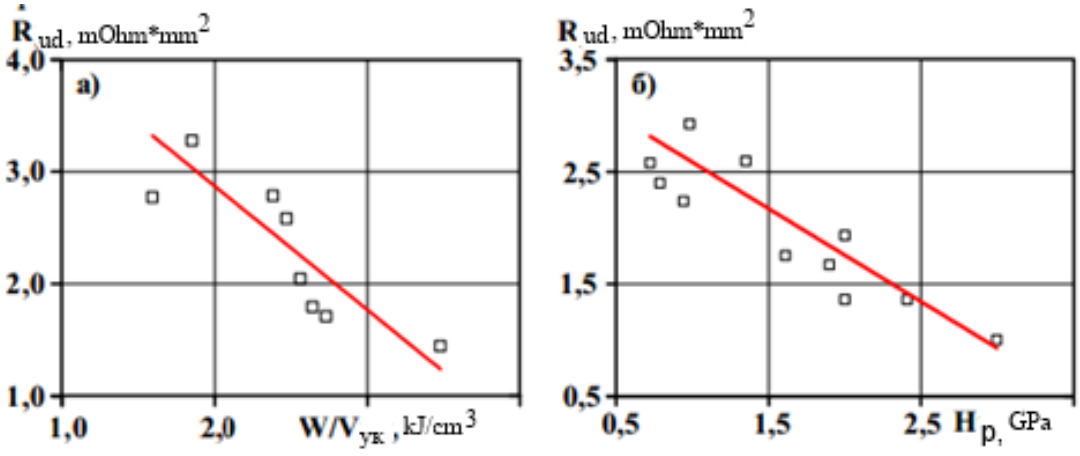


Figure 5 – Dependence R_{ud} from Figure 6. Dependence of R_{ud}.

elements made of aluminum coated with a copper coating combined with the same contact elements and tied up isolated pin. According to these experiments was the dependence of the specific contact resistance of the transition (R_{ud}) on the specific input energy (W / V_{uk}) and on micro hardness of the boundary layer (H_p) for maximum torque bolting M = 100Nm.

W / V_{uk} at M = 100 Nm. H_p at M = 100 Nm.

Study of the phase composition was conducted by X-ray diffraction (XRD). Figure 7 shows the XRD – experimental spectra obtained with the same initial conditions, with different input energy and according to different hardness values in the boundary layer coating-substrate. As can be seen, the main crystalline phase coatings are Cu (space group F 4 / m – March 2 / m) from 67,3 to 75,2%, Al (GHG F 4 / m – March 2 / m) from 2.9 to 26,9%, AlN (PG 4 F / m – 2 March / m) of from 0.5 to 21.7 %, with a slight presence of CuO (PG 4 F / m – 2 March / m) from 5.8 to 21 9 %.

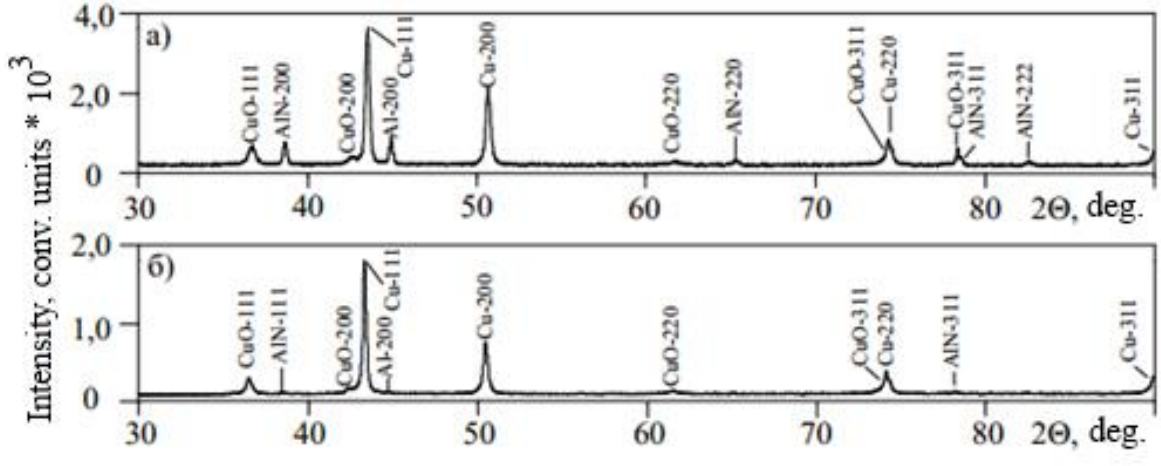


Figure 7 – XRD – spectra of the surface of thin copper coatings deposited in air on a substrate made of aluminum alloy) H_p = 2.0 GPa b) H_p = 1.3 GPa.

Obviously, the material falls into the Al coating to the substrate surface by melting and mixing at high speed hydrodynamic interaction of the jet with the substrate surface. Analysis of the main reflections and broadening the definition of coherent scattering material present in the crystalline phase shows that they are nanostructured. The microstructure of the boundary layer covering the substrate was carried out using optical microscopy on a microscope Olympus GX – 71. For this aluminum substrates coated with copper-coated specimens were prepared vertical cut with ground joints.

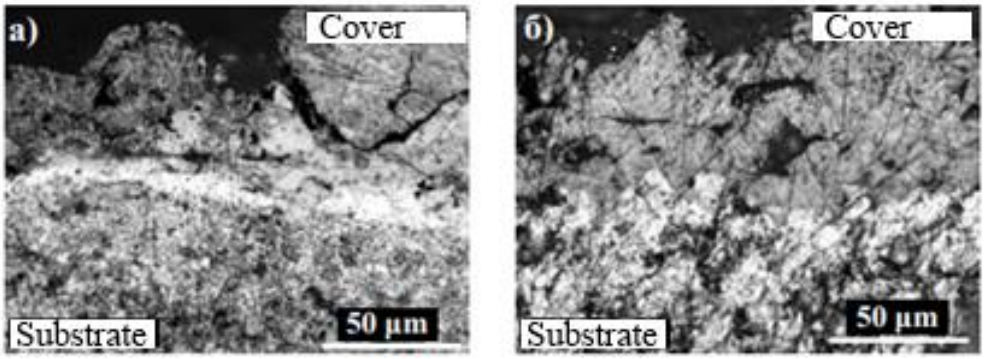


Figure 8 – Optical micrographs of the loop cross-sectional sample of aluminum with copper coating: a) H_p = 2.4 GPa b) H_p = 0.72 GPa.

The analysis revealed that the average coating thickness of ~ 100 microns, homogeneous structure and has practically no pores. In the boundary layer in Figure 8a clearly distinguished white color layer, an average thickness of about 20 microns, presumably AlN. This layer has a higher hardness value ~ 2.40 GPa. Figure 8b of this layer is not visible, and the hardness of the boundary layer is ~ 0.72 GPa. It was thus established that the hardness of the boundary layer depends on the concentration of nitride phases.

This method has the following advantages compared with the others: simplicity, low exposure time (10^{-3}s) and environmental friendliness. Not required dispensed material that works enough electro erosive by accelerating channel with surface copper trunk coaxial magneto accelerator. This method allows us to solve several problems. First, solves the problem of combining a contact pair copper -aluminum. Second, the contact resistance is significantly reduced and hence reduces the energy loss.

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Die Solarenergie in Deutschland

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Abstract: Im diesem Beitrag sind Belange und aktuelle Daten über die Entwicklung die Solarenergie in Deutschland betrachtet und die Analyse des Ausbaus und Nutzens des Solarmarktes in der Bundesrepublik gegeben.

Schlüsselwörter: Solarenergie, Solarbatterien, Leistung.

Das Allgemeine über die Solarenergie in der BDR

Die alternative Energetik wird in der Welt immer mehr gefördert. Die solare Energie bleibt dabei keineswegs abseits. Ihre Rangstufe entwickelt sich mit jedem Jahr unentwegt. Als Zeugnis sind die Materialien der Statistik EPIA. 2012 hat die allgemeine Leistung der Solaranlagen weltweit die Planke von 100 GW überschritten. Die gegenwärtigen Anlagen produzieren so viel Elektrizität wie 16 Kohle- oder Atomkraftwerke.

Europa liegt im Bereich der Solartechnik weltweit vorn. Deutschland kommt dabei eine entscheidende Rolle zu. Zurzeit legen die Deutschen alle Atomkraftwerke in ihrem Land aktiv still. Veranlasst wurde dies durch die Unfälle in Tschernobyl und Fukushima. Folglich entstand die Frage nach der Gewinnung der Energie aus den alternativen Quellen. Das sind Sonne, Wind, Wasser und andere.

Dank solcher Politik wurde Deutschland zum weltweiten Vorreiter auf dem Gebiet der Einführung und Investition in die Solarenergie (Prognose von 2010).

Die wesentlichen Solarkraftwerke und ihre Leistung

Jetzt gibt es in Deutschland mehr als 16 Solarparks. Die größten von ihnen sind „Solarpark Senftenberg II, III“; „Solarpark Finsterwalde I, II, III“; „Solarpark Lieberose“; „Solarpark Alt Daber“.

„Solarpark Senftenberg II, III“ befindet sich neben der Stadt Senftenberg in Ostdeutschland. Er besteht aus mehr als 330 000 Solarmodulen und produziert etwa 82 MW Energie. Solcher Park kann 25 000 Häuser mit Elektrizität versorgen. Der Größe nach beansprucht er etwa 85 Fußballfelder, und sein Bau hat 150 Millionen Euro gekostet.

„Solarpark Finsterwalde I, II, III“ steht in der Nähe der Stadt Finsterwalde. Die Leistung ist 80,245 MW.

„Solarpark Lieberose“ liegt in Lieberose, Brandenburg. Die Leistung der produzierten Energie beträgt 71 MW. Im Park befinden sich etwa 700 000 flexible Solarpaneele, die in der Welt am wirksamsten sind. Solcher Park kann 15 000 Häuser mit Elektrizität versorgen. Sein Platz gleicht 210 Fußballfeldern und sein Bau kostete etwa 160 Millionen Euro.

„Solarpark Alt Daber“. Er könnte 133 Fußballfelder beherbergen und die Leistung ist 70 MW. Er ist an dem Platz des ehemaligen Militärprüffeldes gelegen. Sein Bau hat 150 Millionen Euro gekostet.

Die Solarfirmen. Das weltweite Verhältnis und die Konkurrenz

Am bekanntesten für die Produktion der solaren Batterien sind Firmen „Sharp“, „Q-Cells“, „Kyocera“, „Sanyo“, „Mitsubishi“, „RWE Schott Solar“, „BP Solar“, „SolarWorld“.

„Sharp“ ist die japanische Gesellschaft für die Produktion der Elektronik. Im weltweiten Verhältnis beträgt ihre Produktion der Solarbatterien 28%.

„Q-Cells“ ist das deutsche Unternehmen in Sachsen. Diese Firma ist der weltweit größte Produzent der Elemente für die solaren Batterien. Im weltweiten Verhältnis beträgt ihre Produktion der Solarbatterien 11%.

„Kyocera“ ist die japanische hochtechnologische Gesellschaft. Im weltweiten Verhältnis beträgt ihre Produktion der Solarbatterien 9%.

„Sanyo“ ist der japanische Produzent der Elektronik. Im weltweiten Verhältnis beträgt seine Produktion der Solarbatterien 8%.

„Mitsubishi“ ist die japanische Gruppe der Gesellschaften. Im weltweiten Verhältnis beträgt ihre Produktion der Solarbatterien 7%.

„RWE Schott Solar“ ist die deutsche Firma für die Produktion der solaren Batterien und Module für Photovoltaikanlagen. Im weltweiten Verhältnis beträgt ihre Produktion der Solarbatterien 6%.

„BP Solar“ ist die spanische Gesellschaft für die Produktion der Fotozellen für Solarbatterien. Im weltweiten Verhältnis beträgt ihre Produktion der Solarbatterien 5%.

„SolarWorld“ ist der größte Produzent der Solarbatterien in Deutschland.

Die Aussichten

Vor kurzem haben die Forscher aus dem Institut der Sonnenenergie der Gesellschaft Fraunhofer die Produktion der wirksamsten Fotozelle in der Welt bekanntgegeben. Der Wirkungsgrad der experimentalen Fotozelle beträgt 44,7 %.

Es muss bemerkt werden, dass ihr Vorgänger die Fotozelle mit einem Wirkungsgrad von 44.4 % der japanischen Gesellschaft „Sharp“ war. 2012 waren in Europa die neuen photoelektrischen Anlagen mit 17 GW Leistungen installiert. Den großen Anteil hat Deutschland mit 8 GW. Es hat hiermit ebenfalls Italien verdrängt.

Und einschließlich bis zum 2013 entwickelt sich die solare Energetik in Europa aktiv. Solche gute Ergebnisse besagen, dass „der solare Durchbruch“ außerhalb der Grenzen der

Europäischen Union stattfindet. Vor allem sindt es die USA und China. Nicht umsonst heißt es „In Europa ist es wolkig, in Asien ist es sonnig“.

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Digital Relays vs. Analogue Ones

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The paper shows the trend in replacement of the analogue relays by digital ones. The reasons for their replacement are also considered in the given paper. It is concluded that digital relays are more reliable, fast, compact and possess various operation functions.

The role of protective relaying in electric-power system is explained by a brief examination. There are three aspects of a power system that will serve the purposes of this examination. These aspects are normal operation, prevention of electrical failure, and the reduction of the effects caused by electrical faults.

A protection relay is a smart device that receives input signals, compares them to set points, and provides output signals. This is common for all types of relays (electromechanical, static and digital devices). The input signals can be current, voltage, resistance, frequency or temperature. Outputs can include visual feedback in the form of indicator lights and/or an alphanumeric display, communications, control warnings, alarms, and turning power off and on.

The first protection relays used for power system protection were electromechanical analog devices. Over the last 40 years electromechanical relays have been progressively superseded, firstly by static analogue relays then by digital relays. The development of digital relays has lowered cost and provided greater functionality within each relay.

The protective relaying causes fast removal and disconnection of any element of the power system when it suffers short circuits or is under abnormal and emergency conditions. Relay protection sometimes is even more reliable than the station operators or attendants. The operator needs some time to evaluate the situation and correct it before any harmful consequences develop while the relays respond fast and are able to tackle this problem quickly.

It is well-known that each generator, transformer, bus bar, overhead transmission line are equipped with different types of circuit breakers. Thus, any element can be completely disconnected from the power system. Moreover, the protective relays provide identification of the location and type of failure.

The functional characteristics of any protective-relaying equipment are:

- speed.
- selectivity.
- sensitivity.
- reliability.

First of all, any relaying equipment must be sufficiently sensitive so that it will operate reliably. It must be able to select between those conditions for which prompt operation is required and those for which no response is necessary.

One of the basic requirements of the protective relaying equipment is reliability. Other things being equal, simplicity and robustness contribute to reliability, but they are not of themselves the complete solution. Human factor must be taken into account too.

Like all other parts of a power system, protective relaying should be evaluated on the basis of its contribution to the best economically possible service to the customers. The contribution of protective relaying is to help the rest of the power system to function as efficiently and as effectively as possible in the face of trouble. How protective relaying does this is as follows:.

- by minimizing damage when failures occur,.
- by the cost reduction of repairing the damage;
- by minimizing the likelihood that the trouble may spread and involve other equipment;
- by the time spent during the period when equipment is out of service.
- By the loss in revenue and the strained public relations while the equipment is out of service [4].

Electromechanical relays

Electromechanical relays have been in use for almost 100 years and are still in use for typical utilities throughout their power system. They have earned a well-deserved reputation for accuracy and reliability.

The electromechanical protective relay converts the voltages and currents to magnetic and electric forces and torques that press against spring tensions in the relay. The tension of the spring and taps on the electromagnetic coils in the relay are the main processes by which a user sets in a relay.

These relays are usually instantaneous in action, with no intentional time delay, closing as soon after pickup as the mechanical motion permits. Time delay can be added by means of a dashpot, or a clockwork escapement mechanism.

However, the timing accuracy is considerably less precise than that of digital relays.

Limitations of electromagnetic relays.

- Low speed of operation.
- Characteristics change during exploitation due to ageing effect.
- Component failure causes relay failure.
- Relay is massive: Because there are internal mechanical components with physical dimension restraints, the package size of an electromechanical Relay can limit the size of a PCB design Excessive power consumption.
- Imposes high burden on CT.
- Electromechanical relays must make mechanical contacts in order to switch a load. At the point of these contacts, oxidation breakdown occurs over extended life cycling (typically 100 operations), and the relay will need in maintenance.
- Bounce occurs at the contact site over a period of activated relay . Bounce creates a time interval where the load circuit is flickering between open and closed, a condition which may need to be considered in load design.

Digital relays

Digital relay is state-of-the-art relay that uses a microprocessor to analyze power system parameters for detection of faults in process system. Digital relays can manage system pro-

tection, communication and coordination more precisely and economically than traditional analog electrical-mechanical relays. Numerical algorithms are used in digital relays so any device can be easily duplicate any of the ANSI protection functions with computer program.

A digital relay consists of processor, analogue input system, digital output system and independent power supply. Figure 2 presents a simplified block diagram of a digital relay.

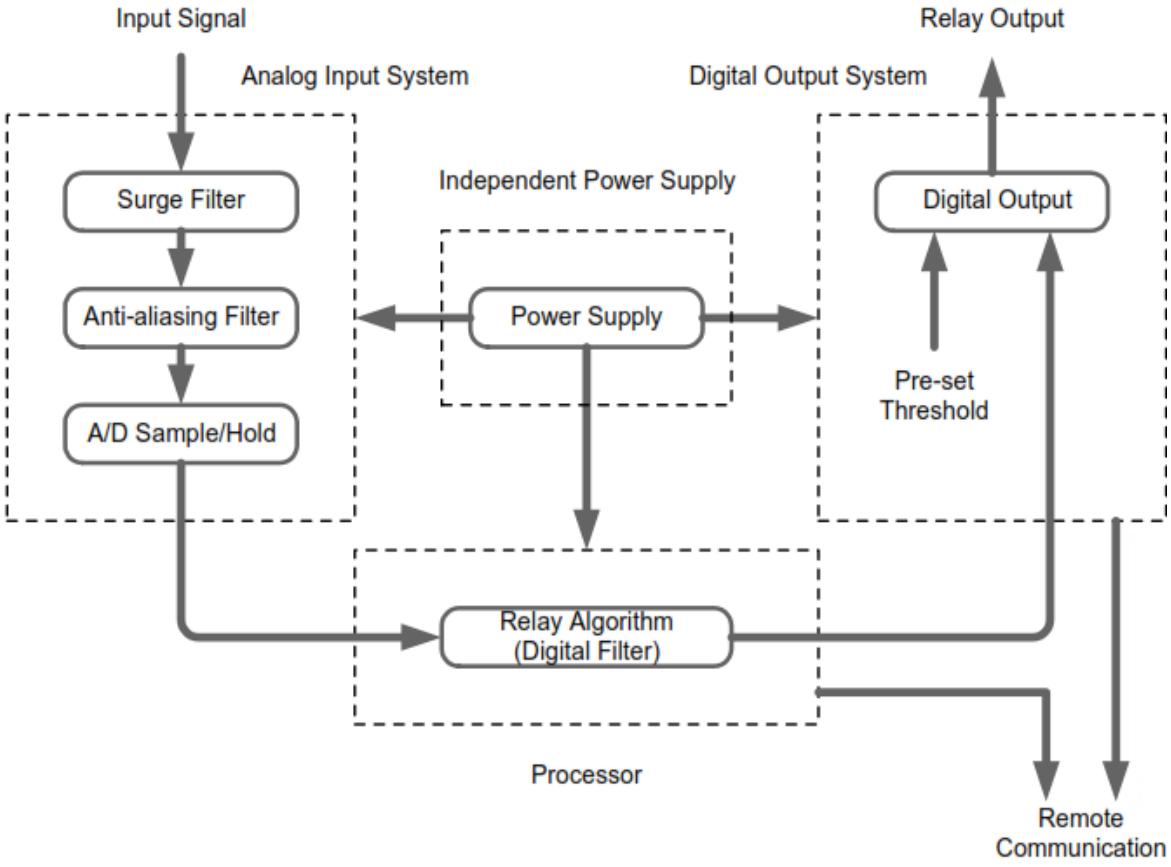

Fig. 2. Block diagram of a digital relay.

The way of input signal processing is the main difference between analog relays and digital relays.

Current transformers and potential transformers generate only analog signal which is input signal. In the case of digital relays, the input signals are converted into digital signals before being processed.

The core of the digital relay is the relay algorithm stored in the processor. It determines the way to reconstruct the input signal based on the digital samples from the A/D converter. As the input signal may contain unwanted components such as harmonics and dc, the algorithm is designed to remove them as much as possible. The algorithm functions as a digital filter to extract the fundamental component of the input signal. The relay operation is carried out based on the fundamental component.

In digital output system, a detection function is calculated based on the reconstructed signal. Such calculated function is then compared with the preset threshold. The decision on whether the relay should operate is made according to this comparison. Sometimes an additional time delay is needed before the trip signal is sent out.

Advantages of digital relays

The main advantages of digital relays are as follows:.

- One digital relay can replace a bank of analog devices.
- Custom functions can be programmed.
- Communication over a PMCS (Power Management Control System).
- Time stamped event recording.
- Self-monitoring.
- Reduced panel space.
- Lower burden.
- Improved performance.
- High seismic withstand.

But these advantages are not limited by the mentioned above.The main drawbacks are listed below:

- Short lifetime due to the continuous development of new modern technologies. Their operation response becomes obsolete rapidly.
- Susceptibility to power system transients.
- The complex and sophisticated design and construction of digital relay protection system requires specially trained staff for proper maintenance of the settings and monitoring data.

Nowadays digital relays are the most reliable, fast, multifunctional equipment.

They haven't drawbacks of analogue electromechanical ones. It's preferable to use digital relays for design new protective relaying.

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Comparison of gas reciprocating and gas turbine power units

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1.Introduction.

Power units or drive electric generators for isolated plants can be diesel, gas reciprocating, micro-turbine and gas turbine engines. A large number of controversial and polemical articles were written about advantages of various generational installations and technologies. Thus, we will try to understand what is better. Fig.1 (left) – Gas reciprocating engine.

Determining the selection criteria for the construction of power units is autonomous power issues fuel consumption level of operational costs, as well as payback power plant equipment.

Important factors in the choice of powertrains are flexibility in application, the level of maintenance and repair, as well as the repair performance place of power units. These issues relate primarily to the costs and problems that may owner of isolated plant will have problems in future.

It should be taken into account such factors as the weakness and backwardness of the generation equipment market in Russia. Actual sales are small in comparison with developed countries and leave much to be desired, and it is primarily displayed on the volume and quality of proposals.

2. Operational costs.

The cost of gas- reciprocating engine overhaul can be 30-35% of the original cost of the power unit and no a whole plant when major repairs carried replacement piston. Repair reciprocating units can be produced locally without sophisticated diagnostic equipment once in 7-8 years.

Fig.2 (left) – Gas reciprocating engine.

Gas turbine plant repair cost is 30-50% of the initial investment. As you can see, the costs are roughly equal. Real honest prices themselves turbine and reciprocating units of comparable capacity and quality are also similar.

On powerful gas engine installations oil change is not required. During continuous operation, it is simply producing without having to grow old. Oil in such facilities are constantly topped up. These modes of operation are provided by a special design of high-power gas engines and are recommended by the manufacturer.

One of the recommended motor oil for reciprocating machines is Pegasus 705 (MOBIL). Its wholesale price is 100-110 rubles per liter.

Burn engine oil is 0.25-0.45 gram per produced kilowatt in hour. Fumes are always higher at lower loads. Typically, the kit of reciprocating gas engine includes a special reservoir for continuous topping oil, and a mini-lab to test its quality and determination of replacement.

Accordingly, oil filters or cartridges in them subject to replacement.

Since the engine oil still burns, reciprocating units have slightly higher levels of harmful emissions than gas-turbine units. But since the gas burns completely and is one of the cleanest fuels. For example, a pair of old Hungarian bus «Ikarus» damage to ecology much more serious harms. According to environmental requirements, using reciprocating engines is necessary to build higher stacks, based on already existing MAC level in the environment.

Same thing on the reciprocating power plants, engine oil consumption does not need to be afraid, because oil is cheap. During normal operation of modern quality reciprocating facilities costs under this heading are only 2-3 kopecks per 1 kW of generated electricity.

In modern gas turbine engines oil is only used in the gearbox. Its volume can be considered a negligible part. Replacing the oil is performed in a gas turbine gear in an average of 1 every 3-5 years, and it does not require topping up.

To carry out the service in full set of powerful gas reciprocating installation, an overhead crane should be included. Using of overhead crane is removed heavy parts reciprocating engines. For the overhead crane it is required high ceilings rooms machine in power plant. For repairing of small and medium reciprocating units can do more simple hoists.

Delivered gas generators can be equipped with various repair tools and appliances. Its presence suggests that even all responsible operations can be made by qualified personnel in

place. Virtually all of the repair work with gas turbines can be carried out either at the factory or factory direct assistance specialists.

It is necessary to replace spark plugs once in 3-4 months. Replacement of spark is just 1-2 pennies a cost of 1 kW / h of own electricity.

Reciprocating units are unlike gas turbines have water cooling, respectively staff autonomous power must constantly monitor the level of coolant and implement periodic replacement, and if it is water, it is absolutely necessary to carry out its chemical preparation.

The above mentioned features of reciprocating units operation are absent in gas turbines. In gas turbines are not used consumables and components, such as:.

- engine oil;
- spark plugs;
- oil filters;
- coolant;
- sets of high-voltage wires.

But at the same time, gas turbine does not repair in place and greater gas consumption cannot be compared with the cost of operation and consumables for reciprocating generators.

3. Ratio of power units capacity and ambient temperature.

If the temperature of the environment considerable increases, gas turbine plant power falls. However, at lower temperatures of a gas turbine electric power installation conversely increases. Parameters of electrical power on the existing standards ISO measure at t +15 ° C.

Fig.3 – Gas turbine engine.

Sometimes the important point is the fact that the gas turbine plant is capable to give 1.5 times more free heat energy than the reciprocating unit of similar capacity. When using large (50 MW) CHP autonomous utilities, for example, it can be crucial when choosing the type of power units, particularly at high and uniform consumption is thermal energy.

Conversely, where the heat is not required in large quantities, and where it is needed to emphasis in the production of electrical energy and it will be economically feasible to use reciprocating systems.

4 . Comparison of efficiency.

Efficiency of the power plant is more than relevant, because it effects on a fuel consumption. The average specific fuel gas consumption per 1 generated kWh / h is significantly less in gas reciprocating installation and for any load conditions (although lengthy load less than 25 % are contraindicated for reciprocating engines).

Electrical efficiency of the reciprocating machine is 40-44% and a gas turbine is 23-33%.

If the consumer intends to use thermal energy isolated plant in full, which is usually unlikely, that the coefficient of efficiency of autonomous power plant has no practical significance.

By reducing the load to 50 % electrical efficiency of the gas turbine is reduced too.

Reciprocating units spend less a quarter or even a third fuel than gas turbine plants. And I should pay attention that it is the main item of expenditure. Accordingly, when a similar or equal the cost of the equipment, cheaper electric energy is produced by gas- reciprocating units. Gas is the main item of expenditure in the operation of autonomous power.

5. Install dual fuel.

Well-known manufacturers of gas turbines have dual fuel units in their range. The main feature of dual-fuel plant is its ability to work on both natural gas and diesel fuel. By using a

dual-fuel installing duel fuels, it is possible to note a number of advantages in comparison with mono fuel units:

• In the absence of natural gas system automatically switches to work on diesel fuel;

• During transients the system automatically switches to work on diesel fuel.

When entering the working mode by the reverse process of transition to work on natural gas and diesel fuel. Do not forget about the fact that the first turbine was originally designed to work specifically with liquid fuels – kerosene.

Dual-fuel plants have still limited application and are not needed for most autonomous CHP, for this is a simple engineering solution.

6. Starts.

Gas reciprocating engine can be started and stopped any number of times, and it does not affect its motor potential . But frequent start-stop piston units, with the loss of auxiliary supply may entail wear the most loaded nodes (bearing, valves, etc.).

Gas turbine unit, due to sudden changes of thermal stresses in the most critical nodes and details of hot section of gas turbine unit with rapid start from a cold state, is preferable to use a constant and continuous operation.

7. Overhaul.

Overhaul of the gas turbine is 40000-60000 hours. With proper use and timely routine maintenance at the gas reciprocating engine, this figure also is 40000-60000 hours. However, there are other situations when the overhaul comes much earlier.

8. Capital investments and prices.

The cost of building gas reciprocating power plants "turnkey" in a building equipped with heat recovery systems and automation is a top-level, depending on the power plant capacity from 900 to 1300 euros per 1 kW of installed capacity.

9. Conclusions

Reciprocating installation can be used as well as a backup or emergency power sources.

The closest competitors of reciprocating units are gas micro turbines. However, prices for micro turbines are strongly up ~ $ 2500-4000 per 1 kW of installed capacity.

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Cables for VFD systems

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Nowadays used a frequency method of smooth regulation of electric drives, built on the bases of asynchronous motors with a short-circuited rotor. This method is based on the using of frequency converters (FC). The power part of the FC consists of a controlled rectifier, filter and autonomous inverter based on the pulse-width modulation (PWD). The great advantages of using frequency converters are of high accuracy and the ability to control constantly the torque and speed of a motor. Also this system has some significant defects: there

is strong electromagnetic emitting and high overvoltage in the power cable and the motor windings.

The high level of electromagnetic interferences is caused by very short intervals of switching-on and switching-off IGBT transistors and the high pulse of a frequency inverter (up to 20 kHz). This leads to a distortion of the converter sinusoidal output voltage. It leads to a distortion sinusoidal voltage on the inverter output. Generally strong electromagnetic emitting is conditioned by a power cable. It induces interferences on the elements of distribution network, devices and information networks. A good shielding of cables provides some neutralization of this emitting.

Another problem is the increased electrical loads on the insulation system. The voltage, generated by the frequency inverter, has the fundamental wave approximately a sinusoidal form with a frequency from 0 to 400 Hz depending on the rotation speed. However, during the operation some higher harmonics are produced at frequencies about 100 MHz. The signal of fundamental frequency and higher harmonics are transferred by a power cable to an electric motor.

The passage of a pulse signal with a steep front induces the wave processes in the cable, leading to overvoltages at the motor adapters.

Wave processes are most dangerous for the insulation of AD winding, because there may arise significant overvoltages (up to 1000 V) at nominal voltage 400 V. When the voltage of the electric field quickly rises on the front of the wave, noticeable dielectric losses arise in the insulation of a machine. Increasing the carrier the frequency of PWD also leads to the probability of occurrence overvoltage and dielectric losses. This is done to improve the energy component of a frequency converter and to approximate useful component of the output voltage of a converter to sinusoidal. Because of these processes the insulation life of AD was reduced to 3-4 years. PWD methods rendered beneficial effect on the output current of autonomous voltage inverters (AVI) and approximated it to a sinusoid. Also these methods simultaneously converted earlier "painless" rectangular form of output voltage for the engine to the series of rectangular pulses, following with a high frequency and having the leading edge of high steepness. Thus, the main drawback of the frequency control using are large electrical loads on the electrical insulation and supply cable. The insulation is rapidly destroyed and the system is failed under the influence of this load.

Electrical loads are adversely affected on the reliability of the supply cable. The formation of impulse waves is possible during the work on the ends of the cables, created overvoltages because of the harmonics reflections (the effect of the reflected wave). This effect arises when the supply cable length exceeds the length of the harmonic wave. If the length is less than the harmonic wave length, the transient processes take place at the output of the frequency inverter. As a result generation the voltage exceeding is rated in 2 – 3 times. It creates alternating loads on the polymer insulation. This factor must be taken into account during designing the cable insulation to avoid insulation damages (for example, because of the formation of an arc between a conductor and a shield). Moreover, overvoltages, acting with the frequency up to 10^{-4} sec, can exceed the value of the voltage supply in 10 times. As a result the life of the supply cable is reduced quickly.

Recently, special cables for variable frequency drives with a pulse-width modulation are developed and produced by the leading international cable companies ("LAPPKABEL", "The Okonite company", "AlphaWire", "HELUKABEL" and the others).

The design features of these cables:

1) Crosslinked polyethylene is used as an insulation. It has great dielectric properties and resistance to corona discharge, giving it an advantage over standard polyethylene or PVC.

2) In the shielding of cables copper or aluminum sheaths are used, providing a high noise security for the low frequency range from 1 MHz to 30 MHz.

3) Symmetrical cable design is used. Bare stranded copper conductors, located in the outer layers of the cable, are used as a grounding.

Nowadays in Russian Federation the work by the creation of such a type of a cable is at the beginning stage. There is not enough information about using the systems of a variable-frequency drive, the methods and criteria of the resistance to overloads, the ways and means of the protection to a corona discharge. In the course of the project is planned to develop cable products, adapted to work in the VFD with the pulse-width modulation, as well as the recommendations for its using.

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Basic design and common types of nuclear reactors

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This article reviews the construction of the existing nuclear reactors. Due to the fact that in many countries approximately 20% and even more of the generated energy is nuclear energy, the development of nuclear energetics is a priority today.

1. The fission process

Before considering the question about the basic design and common types of nuclear reactors we need to review the physical principles of generating heat and electrical energy by a nuclear power station. Given enough fissile material, such as ^{235}U, fission leads to the production of a self-sustaining chain reaction in which the neutrons arising from a given fission cause another fission reaction, which in turn causes another one and so on. Each fission reaction produces two or three neutrons and with an average of about 200 MeV energy. Since only one neutron is required to cause fission, others are available in excess.

One should note that there are supercritical systems, neutrons progressively increase the rate of fission, which is basic of atomic bombs. However, in a nuclear reactor excess neutrons are often absorbed rather than used to produce more fissile material. In addition, thermal or slow neutrons (kinematic energy of less than 10 eV) are used to support the controlled chain reaction. Absorbing excess neutrons often occurs by control rods and slowing down occurs by the moderator.

2. The components common to most types of nuclear reactors

To begin with, in the core, the **fuel** (uranium, plutonium or thorium) undergoes fission so that a lot of heat is released.

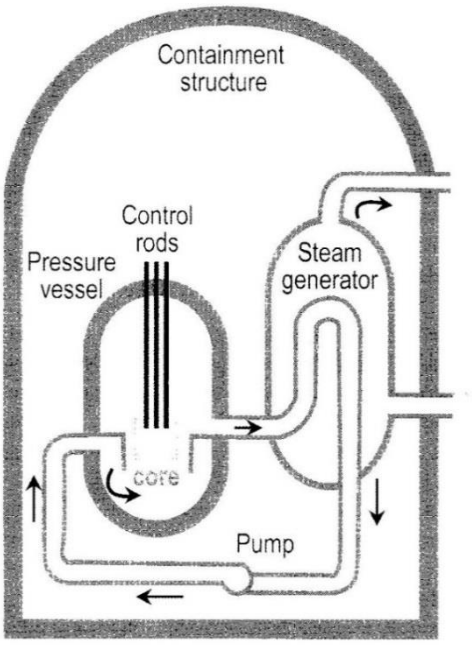

Figure 1. A schematic diagram of nuclear reactor.

Usually it is pellets of UO_2 inserted into tubes to form fuel rods, which are arranged into fuel assemblies in the **reactor core**. A schematic diagram is represented by Figure 1. The next component is the **control rods** made of cadmium, hafnium or boron which are to regulate the rate of the reaction, and therefore heat yield, by absorbing the excess neutrons. The core is immersed in the **moderator** (water or heavy water) and is enclosed in a very thick steel **pressure vessel**. For instance, in a pressurized-water reactor the water, under high pressure, serves both as a coolant and a moderator. In addition, a coolant is a liquid or gas circulating through the core to transfer the heat to a heat exchanger (**steam generator**) where water in a separate circuit is turned into steam, which rotates turbine to produce electrical energy [1.P.28] The process of fission, heat generating and water turning into steam occurs in a big concrete and steel **containment structure**. This component protects the core from outside intrusion and the space around it from radiation.

3. Common types of nuclear reactors.

A pressurized water reactor (PWR) is the most common type of reactors in the world. The reactor of this type was originally designed to drive nuclear submarines.

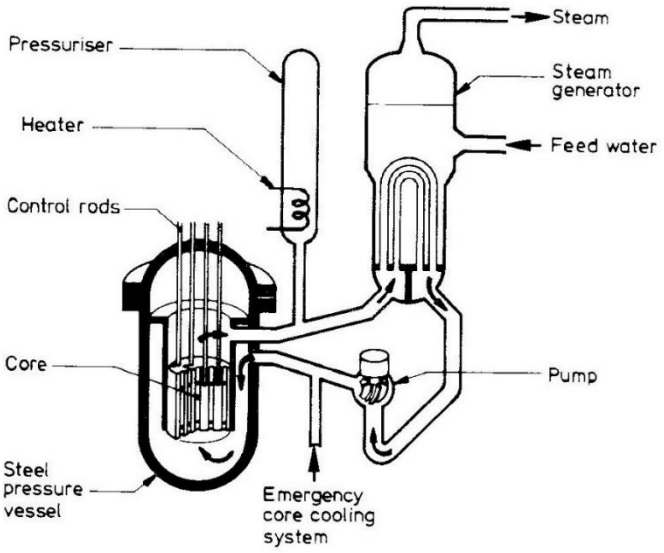

Figure 2. A schematic diagram of PWR.

Electrical energy is generated in the following way: water at typically 150 bars is pumped into a pressure vessel, which contains the reactor core. The water passes downwards through an annulus between the reactor core and the pressure vessel and then flows up over the fuel elements. Then it goes through a series of pipes, which pass to the steam generator. The light water coolant also acts as a moderator for this kind of reactor.

In the steam generator, the hot water from the reactor passes through vertical U-tubes, and water at lower pressure is fed into the steam generator shell and contacts the outside of the U-tubes. Steam is generated approximately at 70 bars, passed from the steam generator into the turbine, and further to the condenser, after the condensate returns to the steam generator through feed preheater. PWRs have typically two, three or four coolant loops. The fuel elements have the form of uranium oxide pellets mounted in a tube made of zirconium alloy. The tubes are mounted in bundles [2.P.43].

From the construction of a PWR, one can conclude advantages and disadvantages of it. The first advantage is the capital cost, which is considerably less than of other types due to the fact that the great reduction of size of the core enormously increases volumetric power density and core rating. The second advantage is that a lot of PWRs can be constructed off-site under factory conditions.

The most significant disadvantage that needs to be addressed is the problem of corrosion on the secondary side of the steam generator. According to some experts this problem can be easily prevented by design improvement. However, the most existing reactors are still prone to the corrosion problems.

A boiling water reactor (BWR) is another type of nuclear reactors (Figure 3), it does not have a steam generator. Water at a pressure of about 70 bars passes through the core, and about 10% of it is converted to steam. Then the steam is separated near the core to move to the steam turbine. The steam from the turbine passes through a condenser, and then the condensate is returned to the bottom of the reactor vessel by a pump system. The fuel elements have form similar to that in PWR and the core power density in a BWR is about half of that in a PWR [3.C.133].

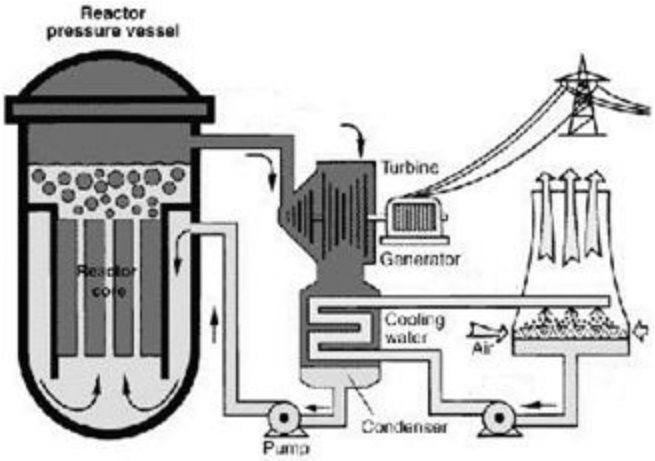

Figure 3. A schematic diagram of BWR

Considering the construction of the BWR one should note here that the most important advantage of this reactor type is the elimination of the steam generator, which has been one of the most troublesome features of the PWR.

Despite the great advantage, the BWR has a few drawbacks. The first one is that a coolant passes through the core where corrosion products may be activated by the reactor neutrons to produce radioactive isotopes, which will circulate around the system. The second problem is that the coolant may transport a small amount of radioactive substances leaking from damaged fuel elements, including rare gases xenon and krypton. So, the reactor must be operated with many external components working in radioactive conditions. The last problem is cracking of stainless steel pipework due to corrosion under the highly stressed conditions. This is similar to the steam generator problems in PWRs. It can be addressed by using a different design approach. **A pressurized heavy water reactor «CANDU» (PHWR) is the type of reactor in which** heavy water is used as a moderator. One cannot deny that PWRs and BWRs require considerable enrichment of the uranium in order to overcome the relatively high absorption of neutrons by the light water coolant. The disadvantages can be overcome by using heavy water as a moderator and either the heavy water or the boiling water as the coolant. If heavy water itself is used as a coolant, it is possible to operate with natural uranium. This is adopted in the Canadian-designed CANDU (Canadian deuterium-uranium) reactors.

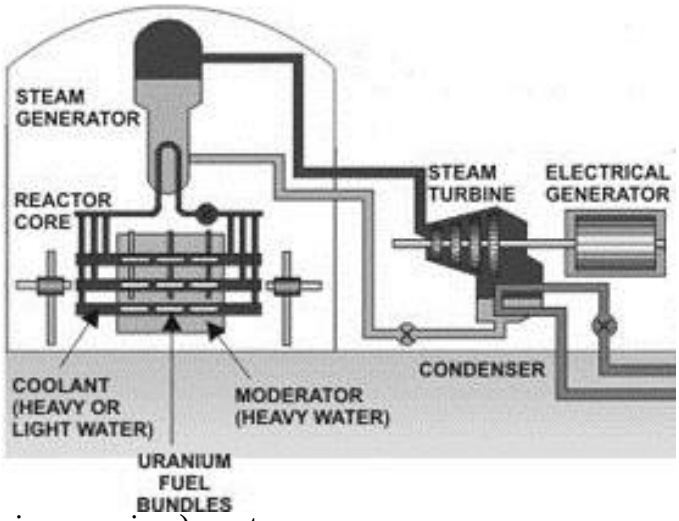

Figure 4. A schematic diagram of CANDU reactor.

CANDU reactors, similarly to BWRs and PWRs, have the massive thick-walled pressure vessel. However, the fuel elements are placed in horizontal pressure tubes constructed from zirconium alloy. These pressure tubes pass through a calandria filled with heavy water at low pressure and temperature. In the CANDU reactor, heavy water coolant is passed over

the fuel elements at a pressure of approximately 90 bars. It then passes to a steam generator, which is very similar to that used in PWR. CANDU reactors have not experienced the same steam generator problems as the PWRs. Experts suppose that it happens possibly because of the lower operating temperature [2.P.48].

The fuel elements consists of bundles of natural UO_2 pellets clad in zirconium alloy cans; individual bundles are about 50 cm long, about 12 of such bundles are placed into each pressure tube. Another fact about CANDU is that the average volumetric power density in the core is approximately one-tenth of that in a PWR.

Although the CANDU has operated with remarkable success, difficulties have been experienced with hydrating of the zirconium alloy pressure tubes. Even though it has a lower fuel cost, CANDU needs considerable amounts of expensive heavy water, which makes its capital cost higher. For this reason the CANDU reactor is less demanded than the PWR and the BWR.

Conclusion

It is undeniable that science has been developing fast nowadays. Progress has influenced the nuclear energy: several new nuclear reactors have been designed and built. These reactors are safer but have higher capital costs, which prevents their large-scale exploitation. Despite this fact, experts are convinced that the number of nuclear power plants will increase in the next 50 years and nuclear power energy will be able to compete with other types of energy.

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Synchronization of Two Induction Motors

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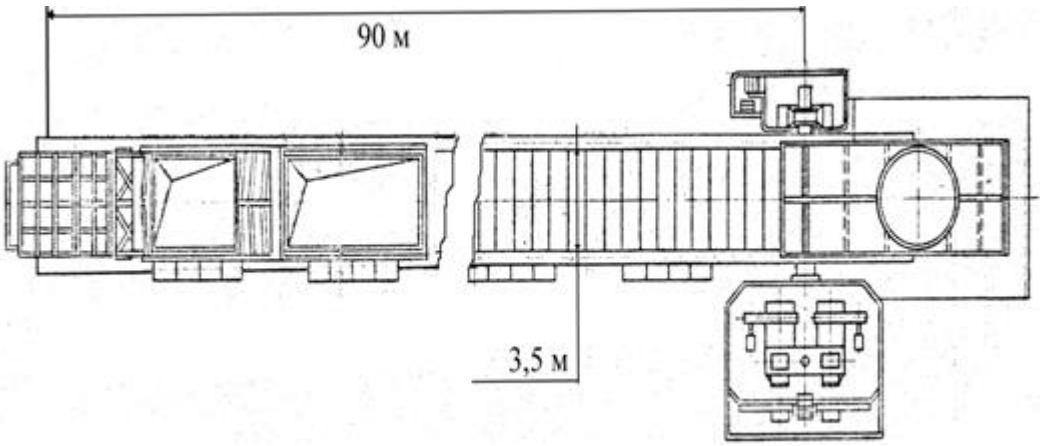

Figure 1 – General view conveyor.

This article is devoted to development of a control system of asynchronous electric motor drive conveyor with two electric motors.

A **conveyor system** is a common piece of mechanical handling equipment that moves materials from one location to another. Conveyors are especially useful in applications involving the transportation of heavy or bulky materials. Conveyor systems allow quick and efficient transportation for a wide variety of materials, which make them very popular in the material handling and packaging industries. Many kinds of conveying systems are available, and are used according to the various needs of different industries. There are chain conveyors (floor and overhead) as well. Chain conveyors consist of enclosed tracks, I-Beam, towline, power and free, and hand pushed trolleys.

Conveyor systems are used widespread across a range of industries due to the numerous benefits they provide.

- Conveyors are able to safely transport materials from one level to another, which when done by human labor would be strenuous and expensive.
- They can be installed almost anywhere, and are much safer than using a forklift or other machine to move materials.
- They can move loads of all shapes, sizes and weights. Also, many have advanced safety features that help prevent accidents.
- There are a variety of options available for running conveying systems, including the hydraulic, mechanical and fully automated systems, which are equipped to fit individual needs.

To increase the capacity two electric motors are used. It is cheaper than buying a powerful motor. However, two motors must be synchronized.

There are two types of synchronized drives of two or more mechanically independent shafts commonly known: one is the "power selsyn" or "synchro-tie;" and the other might be called the "simplified selsyn." The first system uses, besides one or more prime movers, individual selsyn motors for synchronizing. The analysis and application of this type is very well covered in literature. With the simplified-selsyn system, each single shaft is driven by its individual motor, a wound-rotor induction motor, and these motors themselves are used for achieving a synchronized drive, without any additional selsyn motors. So far, the published analyses of this system are very poor and very little information, if any, can be obtained from the literature, which could be used as a guide for planning of such drives. Recognizing this situation, the Armour Research Foundation of the Illinois Institute of Technology made possible the performance of a series of tests which should furnish more basic information on the subject.

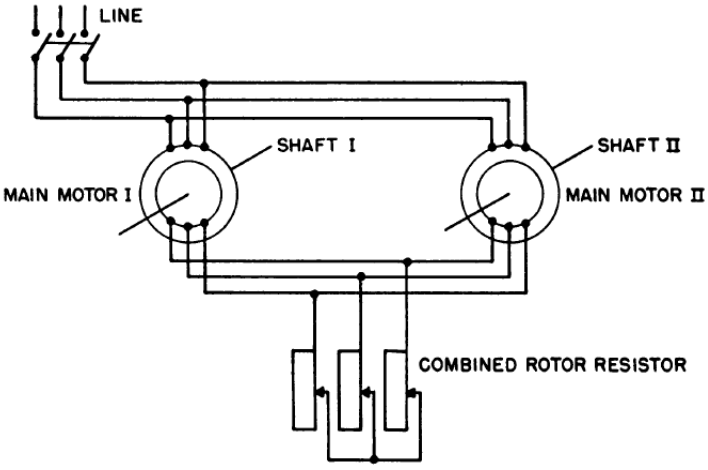

Figure 2 (left) – Diagram of a synchronized drive with two duplicate wound-rotor induction motors.

Figure 2 shows the wiring of two wound-rotor motors for such a synchronized drive. The slip rings of both motors are interconnected, tying the equivalent rotor phases together and a combined secondary resistor is inserted between the tie leads. The ohmic value of this resistor is important for obtaining a satisfactory operation. The two extreme values of resistance are zero (resistor short-circuited) and infinite (no connection be-

tween the rotor tie leads). In the first case, the two motors act as two independent squirrel-cage induction motors without any synchronizing torque, and under different loads the slip of the motors will be different. In the second case, with no connection between the ties and with the rotors in synchronized position, both rotor voltages are in opposition and cancel each other. No rotor current can flow, no torque can be developed, and the motors do not start. The proper size of this secondary resistor is important. Defining *BR* as the base rotor resistance, $BR = E^2 / \sqrt{3} I_2$, where E_2 is the rotor voltage across rings; I_2 is the rated secondary current. The optimum value of this secondary resistor is around 0.23 *BR*. With the transmitter motor fully loaded and this resistor, *0.23BR*, inserted, a synchronized run is secured if the load of the receiver motor is between a maximum 1.95 rated torque and a minimum 0.2 rated torque. With a greater load, the receiver motor will be stalled, and with a load smaller than minimum, the receiver will speed up to almost synchronous speed.

The customary stopping by disconnecting the motor primaries from the line is inconvenient, because there is no synchronizing action during the deceleration period. It is recommended that the drive be stopped by opening the combined resistor circuit and leaving the primaries line-connected. The drives come to rest under the influence of the load, friction, and stop brakes, and an appreciable synchronizing torque is maintained during the deceleration period.

To avoid failures in operation, the shortcomings of this system have to be realized. In the first place, the synchronized run is secured, as previously indicated, only if the load differences between the two shafts do not exceed the permissible limit. However, there are very few cases where the normal or accidental load differences (due to frozen bearings, jammed gears, or the like) safely can be predicted. Furthermore, in case of failure of the power supply, there is no synchronizing torque developed and a displacement is very likely. Consequently, in cases where proper alignment is paramount, the following arrangement of safety devices is necessary:.

1. Automatic control of the angular displacement between the two rotors can be achieved easily by two small selsyns, each rigidly coupled to one motor, and a conventional differential selsyn between the two. The differential selsyn permits observation of the angular displacement at rest and while running, and develops ample torque for control purposes. For example, it can actuate a sliding contact, which opens, through a contactor, the combined resistor leads, in case the angular displacement exceeds the preset limit.
2. Control of displacement also can be achieved by limit switches.
3. The correct arrangement of the motor overload protection is also important. In case just one of the overload relays trips, all motors have to be stopped. As previously mentioned, it is very convenient not to interrupt the motor primaries with these safety devices, but to disconnect the leads to the secondary tie resistor.
4. Another requirement is provision for realignment. This is achieved by arranging a key-locked switch, which permits operation of only one motor in both directions, and which bypasses all the alignment controls.

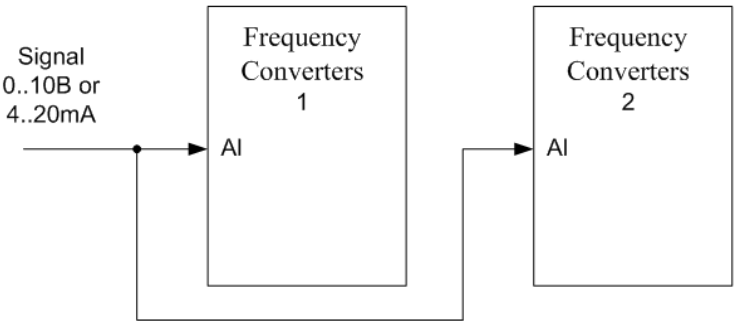

Figure 3 (left) – Synchronization on the parallel interface.

However, another system must be used for the conveyor,

the system is more expensive but it is more efficient at the same time. It consists of two motors, two frequency converters and a controller. This system was the goal of my research.

It is possible to adjust the offset velocity by scaling an analog input frequency converter 2 or analog output of the frequency converter 1. It can be implemented almost on any models of frequency converters with a good analog output (bit digital-to-analog converter not less than 10).

In its simplest form, you can just give a parallel task like that:

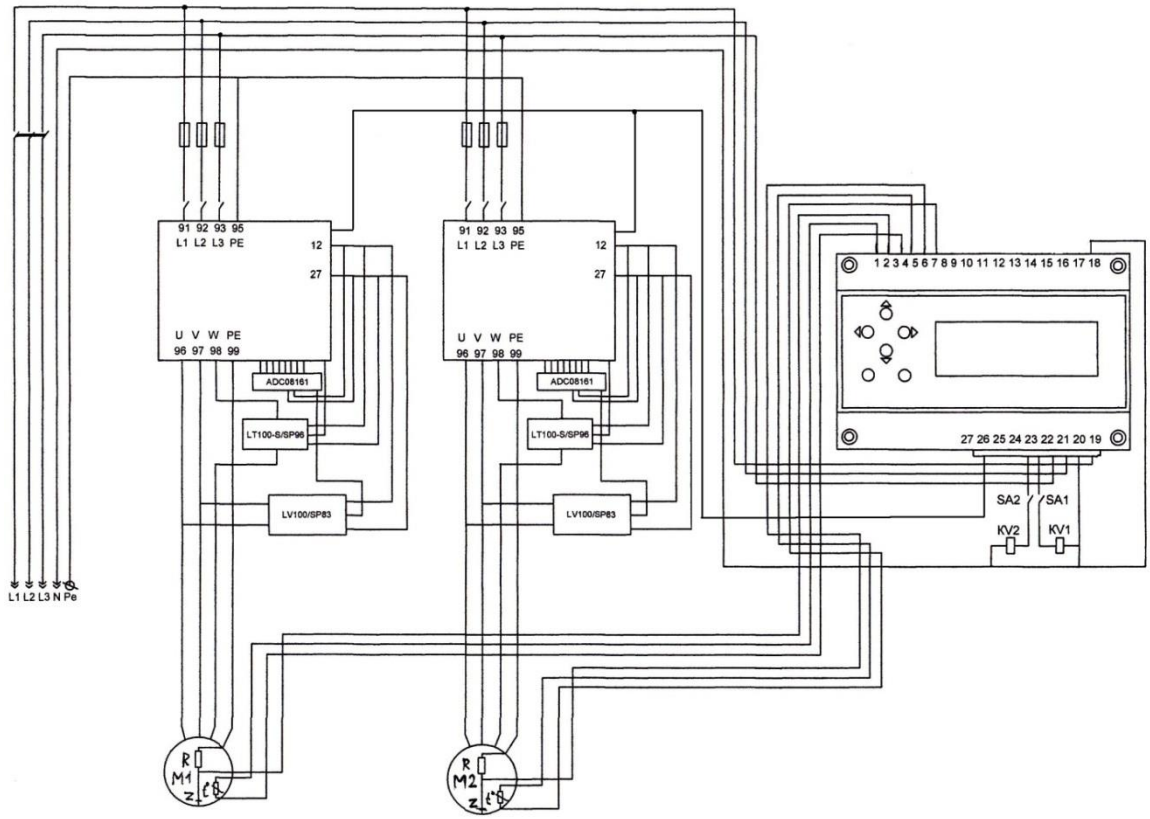

Figure 4 – Schematic diagram. A circuit diagram which shows: a control device two frequency converter and two motor, and various sensors has been introduced.

In Figure 5 we see the mechanical characteristic. On the characteristic 1+2 summed moments electric motors.

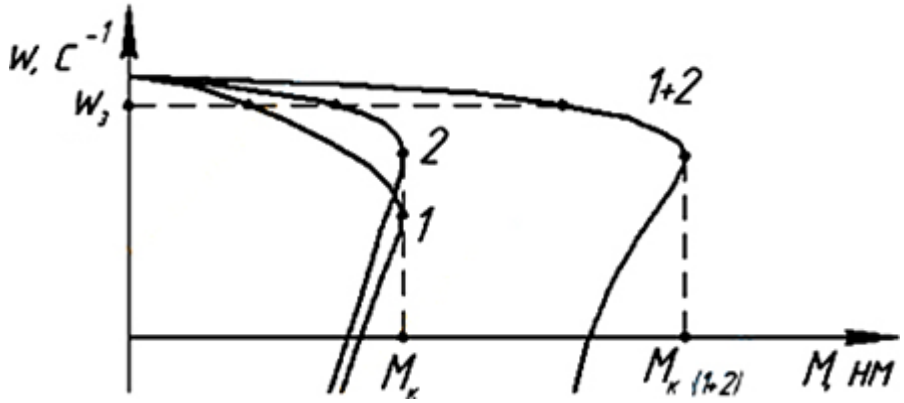

Figure 5 (left) – Teamwork electric motor operating in different modes.

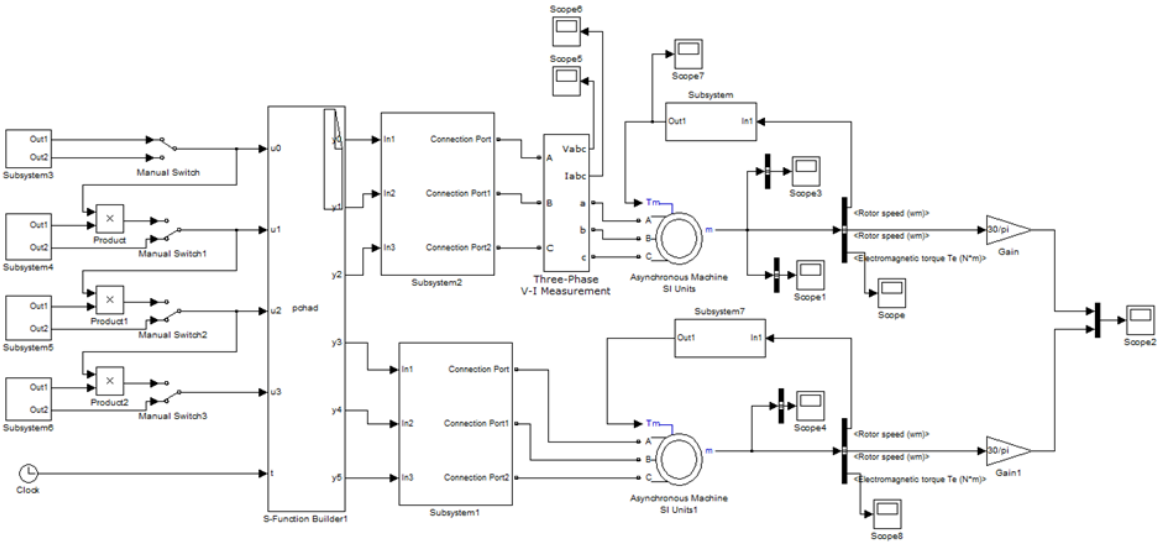

Figure 6 – Simulation model in Matlab program.

A simulation model which is under development has been introduced as well. It will investigate such modes as jam mechanism jams, maximum load start, as well as the failure of a single drive.

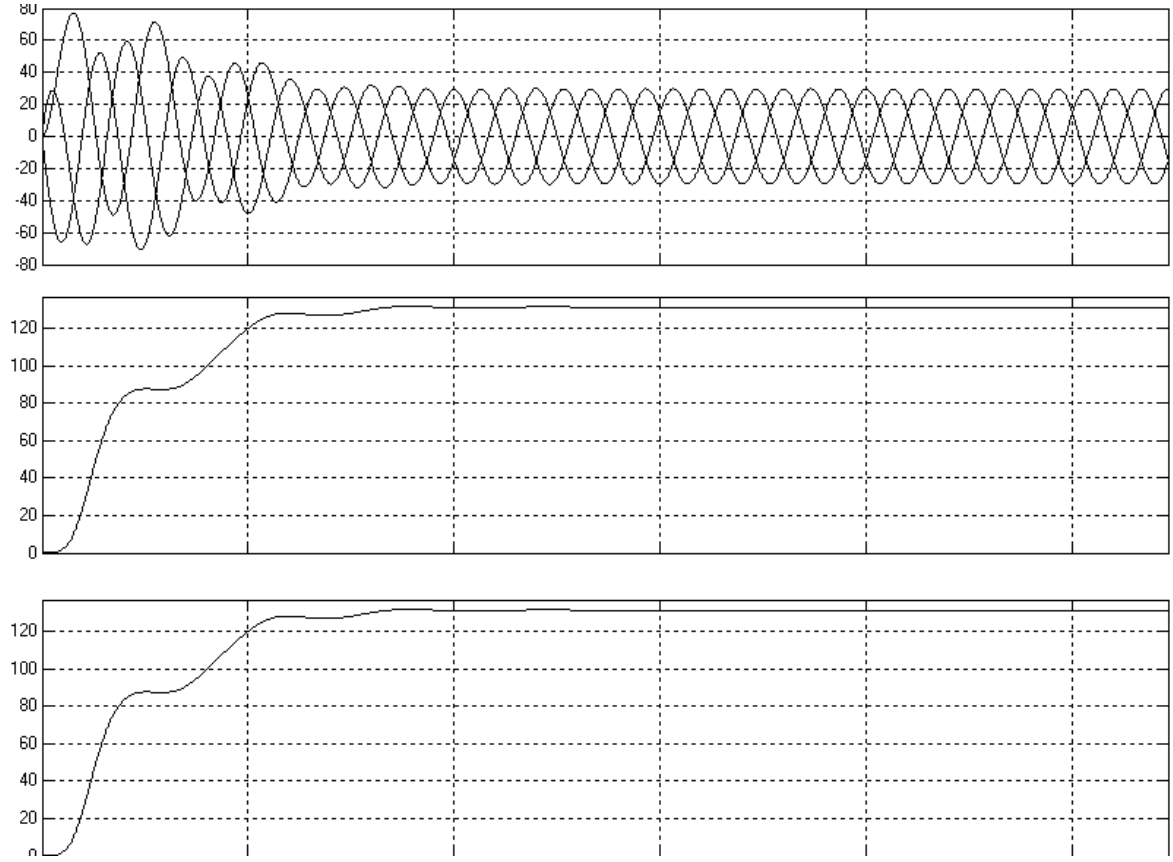

Figure 7.

In Figure 7, we see two synchronized engine speed. This is the result of synchronization in Matlab program.

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Power balance of the Siberian Federal District: dynamics and prospects

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Introduction

Issues of energy management and energy efficiency are of high importance in the world.

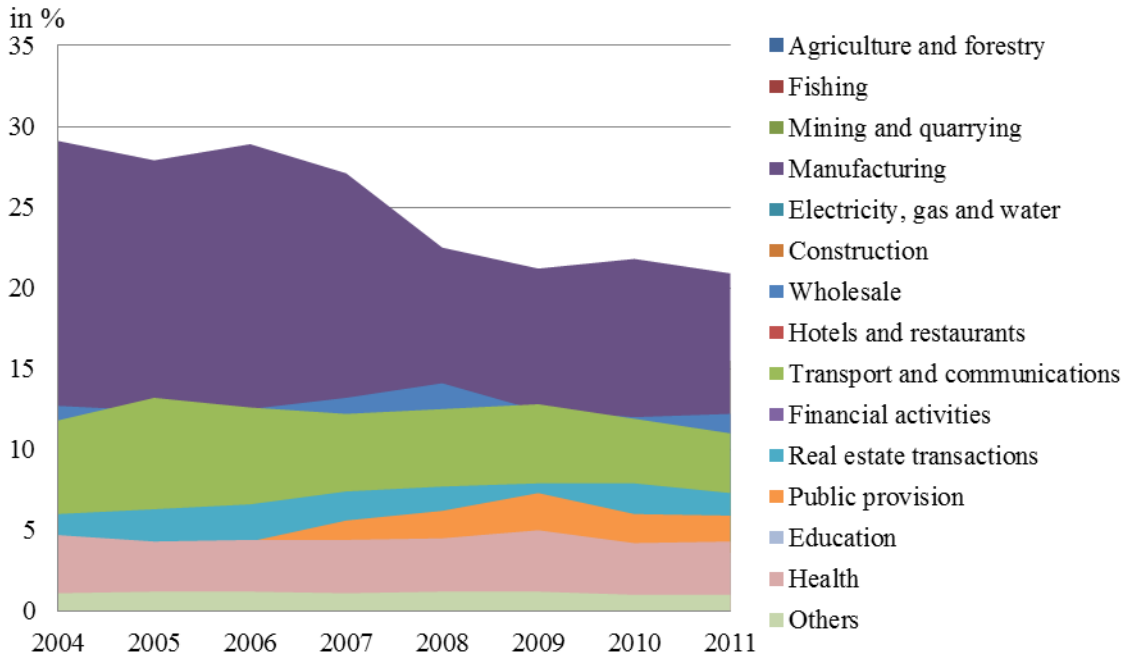
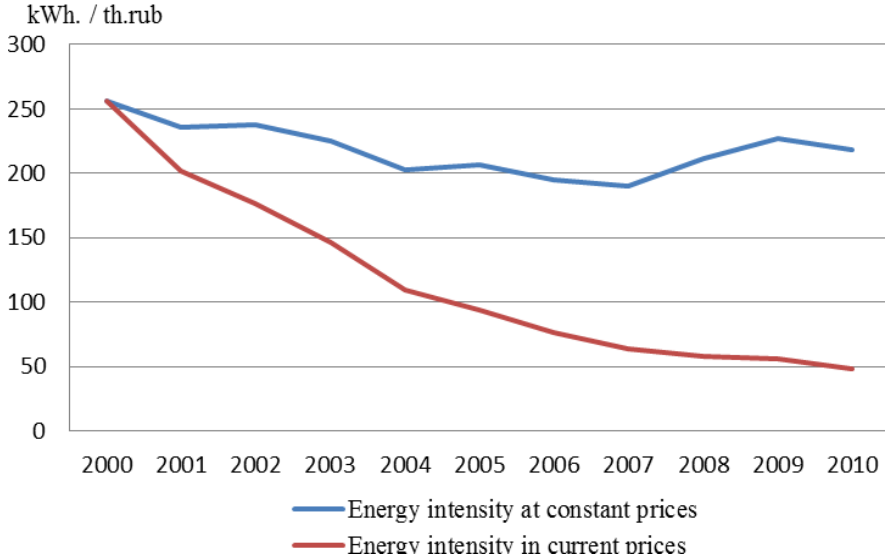


Fig.1 Structural Dynamics of GRP under comparable conditions relative to 2000.

Siberian Federal District (SFD) possesses fuel, energy and raw material recourses, satisfying not only own needs for fuel and energy resources (FER), but also being a major supplier to other regions.

The Balance of electrical energy efficiency (EE) is a partial derivative of the composite energy balance in SFD considered in [1, 2] and of the socio-economic level of development of the territory, as well as an indicator of effectiveness concerning the implementation of the State policy in the field of energy conservation.

Adoption in 2008 of the Presidential Decree number 889, and in 2009 the Federal Law number 261 was the impetus for the development of long-term programs in the area of energy efficiency [1] The main indicators of energy efficiency in accordance with the legislation are: the combined energy balance, private energy balances, indicators of socio-economic development, energy and electricity production unit of gross regional product, the consumption of energy resources and energy efficiency per capita.



Despite the fact that all developed the paralysis of energy efficiency compared to 2009, the authors in this paper use statistical data from 2000, as a large selection enables more correct predictions for the future, improving the accuracy of the models and conclusions.

Fig.2. GRP electricity intensity in current and comparable conditions.

Energy Efficiency Indicators

SFD is one of the few districts of Russia, which is almost self-sufficient in energy efficiency of its own production, 96% of which goes to power plants and hydro. During the time, the production of EE at SFD increased by 6%, and consumption by 13%.

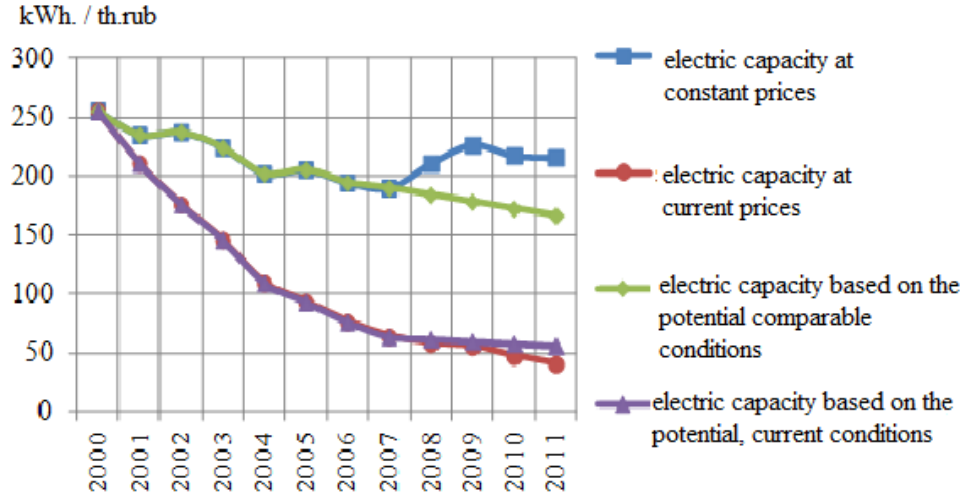


Fig.3. GRP electricity intensity in current and comparable conditions with and without the energy saving potential.

The most significant factor affecting power consumption is the gross regional product (GRP), its structure and the possibility of changes in the future. Thus, in the current circumstances manufacture GRP SFD data regarding 2000 increased by 7.3 times. 66% generated GRP accounts for the Krasnoyarsk Territory, Irkutsk, Kemerovo, Novosibirsk region. In the industrial structure it is dominated by the GRP manufacturing (21%), transport and communications (13%), wholesale and retail trade (13%), organizations that work with real estate and public administration (15%), extractive industries (10%).

Fig. 1 shows that the share of economic activity is really creating products in values of 66-69%. Depending Graphs shown in Fig. 2 show the natural decline of electrical capacity in the current environment.

Fig. 3 shows us that in comparable prices GRP electricity intensity in 2011 were 216 kWh / thousand rubles, which are 40 kWh / thousand rubles less than 2000. Reduction occurs mainly due to changes in the structure of GRP toward non-energy activities. If you save electricity consumption trends observed in the SFD in the near future can be estimated using the equation obtained in the program STATISTICA.

$W'_{\text{ВРП}} = 2230{,}1409 \cdot x - 4{,}2868 \cdot 10^6$, *mln kWh.*

Taking into account the implementation of energy-saving electric capacity assigned by 2020 it should reach 114 kWh / thousand rubles. In accordance with the state program of energy saving potential it is supposed to achieve this by raising extra budgetary sources and further reduce the proportion of non-energy activities in GRP. Equation takes the form:

$W'_{\text{ВРП}} = -2604{,}9007 \cdot x + 5{,}3973 \cdot 10^6$, *mln kWh.*

What changes in the pattern of capacitance by type of economic activity will occur in the future, we cannot say now, because there is no forecast of socio-economic development of the SFO until 2020. In 2011 values of electric capacity FEA have reached the following rates (Table 1).

Table 1. Electric capacity production by economic activity

Economic activities	kWh / thousand rub.
Extractive industries	59,1
Manufacturing industries	79,7
Production, distribution, energy efficiency, gas, water	17,2
Construction	2,2
Agriculture and forestry	3,3
Transport and communications	18,4
Others	17

Mining and manufacturing industries (Table 1) are characterized by the production of electrical capacitance; therefore, search for the major reserves of energy savings should start with them.

Conventionally, all economic activities can be divided into creating the means of production and creating consumer goods [3] That is, the end user of direct and indirect products of economic activities is the population. Purchasing consumer goods, the population pays electrical component in the cost of production at unregulated prices for industrial consumers. Consuming energy in households, the population pays its regulated prices approved by the Departments of tariff regulation or the Regional Energy Commissions.

Table 2. Population

	2000	.....	2010	2011
Per capita income, thousand	1933	…	15007	16568
Per capita consumption of EE kWh	958	…	1174	1282
Abundance, thousand	20333	…	19252	19261

In Siberia there is a stable trend of decrease of population alongside with rising consumption of electric energy (EE) (Table 2). To explain the increase in per capita consumption of energy efficiency on the background of ever-increasing rates is possible only against the background of the welfare of citizens.

In terms of implementation of energy saving policy population – the most severe category of consumers and the state is looking for incentives, for example – the social norm of consumption of electricity for the population. On the other hand, it is a hidden increase in tariffs for the population.

While maintaining the existing trends we obtain the following equation forecast relating to electricity consumption for this group.

$W_P = 68,3287 \cdot x^2 - 2,7362 \cdot 10^5 \cdot x + 2,7394 \cdot 10^8$.

On average, the increase in SFD equal to 1500 rubles per capita income will increase consumption of electric energy corresponding to 100 kWh per year.

Consumer power balance part will consist of the sum of two units.

$W = W_{GRP} + W_P$.

In the current situation, when frequent accidents occur at electric power facilities, there is a growing need to replace power equipment. The cost of production of fossil energy resources dominates in the share of the energy balance, as a result, the importance of planning and forecasting electric balance on territories is on par with the state policy to improve energy efficiency of the country.

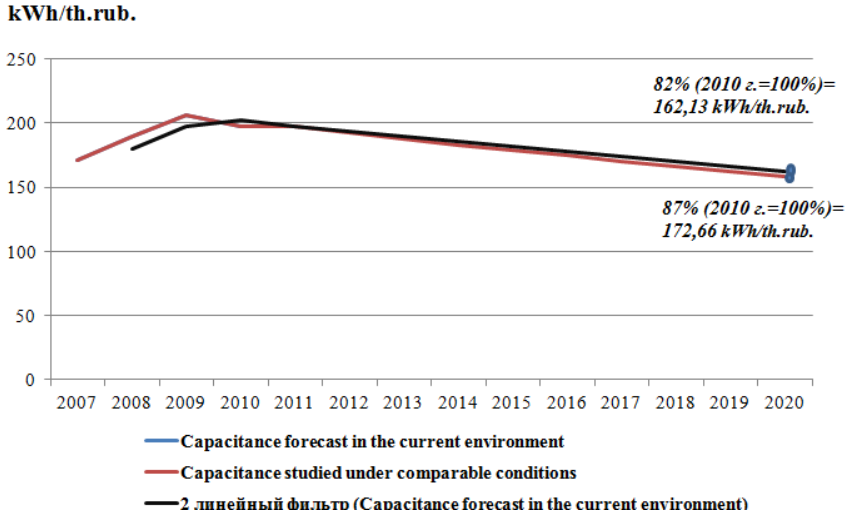


Fig.4. Study dynamics GRP SFD in the future from 2011 to 2020.

So, following the scenario of social and economic development of the 2030 Russia:

1. Production of the GRP should increase to 45% the year; (2007 = 100%).
2. Electric capacity should decrease in 2020 by 18%; (2010 = 100%).
3. The share of consumption EE should decrease by 20% by 2020; (2010 = 100%).

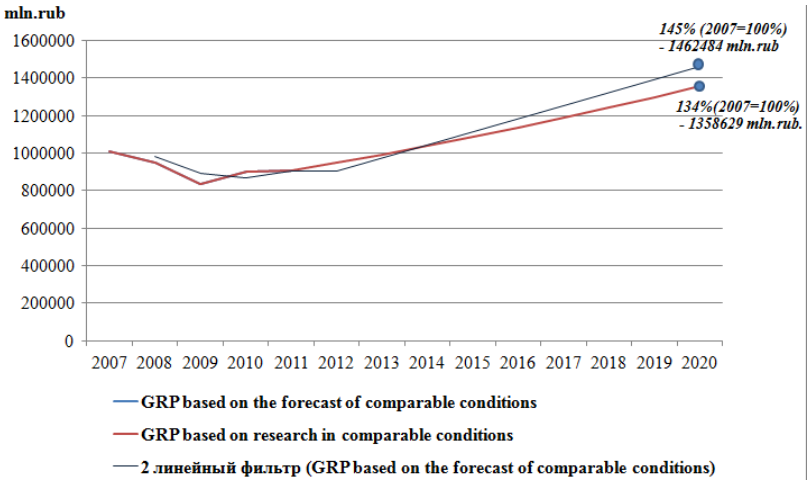


Fig.5. Study the dynamics of electric capacity (EC) GRP SFD in the future from 2011 to 2020.

I did some research changes relating to the dynamics of the GRP, by changing its structure.

While not affecting the trend of GRP. Thus: with the increase of non-energy sectors (Agriculture and forestry, Transport and Communications, Building) from 2011 to 2020 and decreasing share of energy from 2018-2020 (mining, manufacturing, production quantity and distribution of EE), the share of GRP SFD continues to grow and the final year in comparable terms increased by 34%.

Also was approximate forecast electric capacity 2020 in comparable prices. So with due decrease of 18%, capacitance decreased by 13%.

Conclusion

The plan may include energy efficiency of the economy in my opinion:

1. Introduction of energy-saving technologies that will reduce the burden on the economy due to lower energy consumption and reduce the cost of production.
2. Qualitative and accurate planning and forecasting, power balances;.
3. Implementation of innovative programs, as well as the introduction of new energy facilities and replacement of the existing outdated equipment.

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HVDC transmission systems

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The application of HVDC transmission systems

The issue of application of HVDC transmission is very urgent nowadays since the use of power electronics in this system enables to reduce power losses and as a result increase its efficiency.

A high-voltage, direct current (HVDC) electric power transmission system uses direct current for the bulk transmission of electrical power, in contrast with the more common alternating current systems. For long-distance transmission, HVDC systems may be less expensive and suffer lower electrical losses. For underwater power cables, HVDC avoids the heavy currents required to charge and discharge the cable capacitance each cycle. HVDC allows power transmission between unsynchronized AC transmission systems. Since the power flow through an HVDC link can be controlled independently of the phase angle between source and load, it can stabilize a network against disturbances due to rapid changes in power. HVDC also allows transfer of power between grid systems running at different frequencies, such as 50 Hz and 60 Hz. This improves the stability and economy of each grid, by allowing exchange of power between incompatible networks.

Principle of operation

High voltage is used for electric power transmission to reduce power losses due to wire resistance. Unfortunately at present there is no method to vary DC voltage level without any

power losses. The most effective device for changing the voltage level is transformer working on alternating current.

Therefore, transformers are installed at the input of high-voltage transmission lines to increase AC voltage. Equipment to convert alternating current to direct current is also installed at the input of high-voltage transmission lines while the equipment intended to convert DC to Ac is mounted in the output of these lines.

Practical conversion of power between AC and DC became possible with the development of power electronics devices such as mercury-arc valves and since 1970 semiconductor devices such as thyristors, integrated gate-commutated thyristors (IGCTs), MOS-controlled thyristors (MCTs) and insulated-gate bipolar transistors (IGBT) have also been widely implemented.

The components of an HVDC transmission system

The three main elements of an HVDC system are: the converter station at the transmission and receiving ends, the transmission medium, and the electrodes.

The converter station at each end is replicas of each other and therefore consists of all the needed equipment for going from AC to DC or vice versa. The main components of a converter station are:

- thyristor valves;
- voltage-source converters (VSC). The VSC converter consists of two level or multilevel converter, phase-reactors and AC filters;
- transformers. The converter transformers adapt the AC voltage level to the DC voltage level and they contribute to the commutation reactance;
- AC Filters and Capacitor Banks;
- DC filters.

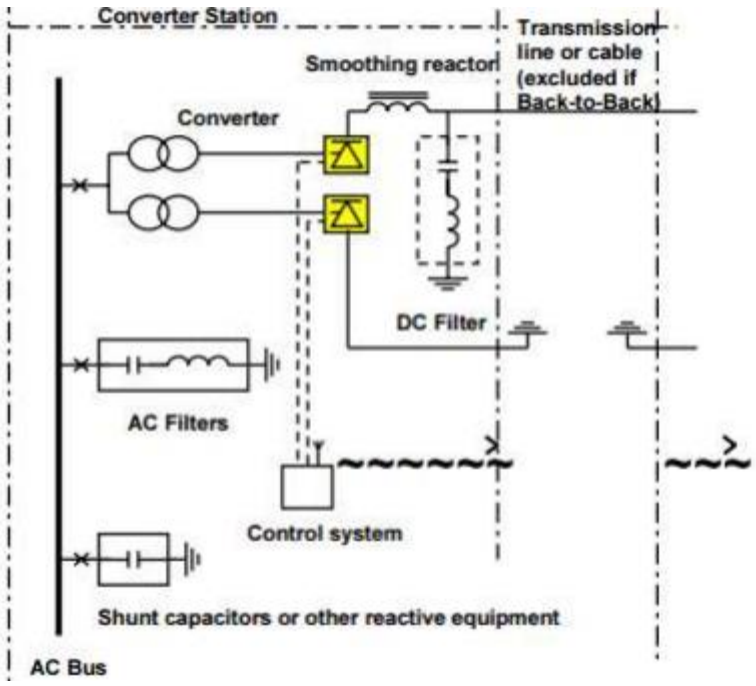

Figure 1. Components of HVDS transmission systems.

Comparison of AC and DC transmission

Advantages of DC are as follows:

- more power can be transmitted per conductor per circuit;
- use of ground return possible;
- smaller tower size. The DC insulation level for the same power transmission is likely to be lower than the corresponding AC level. Also the DC line will only need two conductors whereas three conductors are required for AC. Thus, both electrical and mechanical considerations dictate a smaller tower;
- higher capacity available for cables;
- no skin effect;
- lower short circuit fault levels.

However, there are some inherent problems associated with HVDC:

- expensive converters. Expensive Convertor Stations are required at each end of a DC transmission link, whereas only transformer stations are required in an AC link;
- reactive power requirement. Convertors require much reactive power, both in rectification as well as in inversion;
- generation of harmonics. Convertors generate a lot of harmonics both on the DC side and on the AC side. Filters are used on the AC side to reduce the amount of harmonics transferred to the AC system. On the DC system, smoothing reactors are used. These components add to the cost of the converter.
- difficulty of voltage transformation. Power is generally used at low voltage, but for reasons of efficiency must be transmitted at high voltage. The absence of the equivalent of DC transformers makes it necessary for voltage transformation to carried out on the AC side of the system and prevents a purely DC system being used;
- absence of overload capacity. Convertors have very little overload capacity unlike transformers.

Conclusion

The most common reason for choosing HVDC over AC transmission is that HVDC is more economic than AC for transmitting large amounts of power point-to-point over long distances. High power HVDC transmission scheme generally has lower capital costs and lower losses than an AC transmission link, when used over long distance router.

Even though HVDC conversion equipment at the terminal stations is costly, overall savings in capital cost may arise because of significantly reduced transmission line costs over long distance routes. HVDC needs fewer conductors than an AC line, as there is no need to support three phases. However, thinner conductors can be used since HVDC does not suffer from the skin effect. The above mentioned factors can lead to large reductions in transmission line cost for a long distance HVDC scheme.

Depending on voltage level and construction details, HVDC transmission losses are 3,5% per 1,000 km, which is less than typical losses in an AC transmission system.

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Soft skills for successful professional career

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Sometimes the importance of human skills for every workplace is underestimated. Nowadays challenging economic situation means that it is no longer sufficient for new graduates to have knowledge of an academic subject and it is necessary for a student to gain the skills which will enhance their prospect of employment. And future engineers must learn and develop in the classroom some knowledge and skills during studying. Because undergraduates may not be aware of the importance of human skills for their future employment and professional development. They can meet the question like this: Beyond technical skills, what

added value can you bring to our company? Therefore all your human skills are critical for you.

There are two types of human skills, the first type is soft skills and the second one is hard skills. Primarily the hard skills should be considered. The hard skills are identified as specific, teachable abilities that may be required in a given context, such as a job or university application. Hard skills can be defined and measured. And usually they are acquired by getting through different trainings and life experiences. They can be: facility with spreadsheets; typing; proficiency with software applications; operating machinery; software development; speaking a foreign language; data and text processing and etc.

And the second type of human skills is soft skills. They are personal qualities and attitudes. Honesty and respect; positivity and responsibility; creativity and teamwork; adaptability to change; attendance or timeliness; leadership skills; making decisions, effective communication and etc. are all included in soft skills. Below some of them are taken a look at [1].

Honesty and respect. It is really important to be honest and show respect with people. If you are respectful and honest with people, they will be honest and respectful with you too. Therefore your virtues will work for you and you can govern your success in your social and business life. And definitely you will be able to expect positive responses from the others by giving respect and consideration because they determine how well and peaceful you will relate with family, friends and people at large [2].

Positivity and responsibility. Denis Waitley said "You are responsible for your life, and your ultimate success depends on the choices you make". Usually people are irresponsible because of their simple laziness or a fear of failure, through a sense of feeling overwhelmed by the scale of a problem or a situation. All the causes of the irresponsibility are important it might be failure in their job or their team or even they can fail to grow as individuals. There are several signs when people are shirking their responsibilities. They can be such signs as lacking interest in their work, blaming others for mistakes and failures, not taking risks, avoiding taking initiative and etc. That is why it is necessary to provide people with skills and resources needed to do their job by creating comfortable environment where it is easy to take responsibility for their actions and decisions. If there is an irresponsible person some steps can be taken to change him or her. These steps include talking with individual; ensuring adequate resources; explanation of the role of the person; re-engaging; help to take control and etc [3]. And undoubtedly the positivity is also significant part of the soft skills. People often are predisposed to think negatively. Stress and depression make people think negatively. Studies have shown that positivity, or optimism, is linked to longer life, increased pain tolerance and better overall health. Thinking positively allows people to see the bigger picture and make better decisions under duress. Ultimately, they make more money and are more likely to get promotions. The difference between optimistic and pessimistic is that when adversity has happened the optimistic will begin thinking of solutions and the pessimist will think of despair. And the main way to change your mind and think positively is concentration on good and perspective things [4].

Creativity and teamwork. Doubtless the creativity and the team working are inherent parts of the work process especially in a big team. Effective team must have common elements: clear goal; a results-driven attitude; competent team members; unified commitment, which means that all individuals must be directing their efforts towards the goal; a collaborative climate; high standards that are understood by all; external support, encouragement and principled leadership [5]. The productive team working includes effective communication. For useful and productive work people should use rounds. One of the major problems

relating to working in a team is that it can be easy for the powerful to dominate the weak. Using "rounds" enables the leader to manage the group in a democratic way, so that the weak can be as powerful as the strong. Any participant can stop the discussion and ask for a round. Each participant must then state his or her view on the subject, without fear of being interrupted. Additionally working in the team you can also stimulate creative thinking. We are all creative by nature – we just need to develop our internal creativity. Three easiest ways to jump-start creativity are: keep a journal with you and you will be able to write your creative ideas down; relax and take time to absorb your thoughts; create a thinking place that encourages a positive and relaxed mood that will stimulate your creativity.

Adaptability to change. Adaptation is more than a merely attitude; it is a behavioral skill which improves individual and organizational productivity. The most successful individuals in negotiating and adapting to changes can see and embrace change as a catalyst for positive results. The most useful activities in adaptation are: recognize that change does happen; be aware of your surroundings; communicate with others; do a self-assessment and be flexible [6].

Attendance or timeliness. Every employer expects you to be at work on time. Of course there are some acceptable reasons for absence: illness; family sick leave; vacation and personal leave. Thus, employer pays you for a specific number of hours per day and expects that you arrive at your assigned area on time. Therefore absence from work will mean that the job, which you have to do, does not get done and somebody else has to perform your work. No one of your coworkers will approve of waiting for you. Therefore, when you arrive to workstation and appointments on time, you have an essential career soft skill. Making decision. You must review all ideas and choose more optimal for an assigned task, advisable to listening to different thinkers. For decision-making you can also use "round", which help discuss the best decision.

Effective communication. There are several ways for developing effective communication skills. Individuals' communication skills are a basis for an effective dialogue, and involve both verbal and nonverbal communication skills. One of the main verbal communications is listening. Listening is probably the most used skill in everyday communication. It involves hearing and paying attention to the speaker. Not everybody is a good listener – some people prefer to talk [7]. Everybody knows the main rules: pay attention to the speaker, first of all, in order to show you are involved in communication. Respond both verbally and nonverbally, showing that the message is being comprehended and followed. It should not interrupt the speaker in the middle of a speech. Ask questions and confirm your understanding of the message [8]. And the second no less important verbal effective skill is speaking. Because though everybody speaks every day, not everybody can do it well. Some people are difficult to follow, some explain their thoughts in a complicated manner, and some are simply boring to listen to. To make a fascinating statement plain and simple word should be used unless the audience is specialized in the subject area. Use complete simple sentences for the message to be easier to comprehend. Of course, one shouldn't speak too fast. For a more expressive speech one should make pauses. Structure and connect ideas. Major points should be presented in a logical manner. And one should support ideas not only with words, but with intonation and nonverbal means of communication as well.

Not all soft skills are presented in this paper, but the main soft skills. Every soft skill can lead the worker to promotion and recognition by the coworkers. Thus, hard and soft skills are often referred to when applying for a job. For most jobs, while the hard skills are essential to getting the interview, it's the soft skills that will offer the job because employers want

someone who won't just perform their job function, but will be a good personality fit for the company and make a good impression on clients [9].

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Investigation of radiation by Geiger- Muller counting tube

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At the moment there is a problem with radiation monitoring of the environment. For this purpose, there are different technical devices such as dosimeters, ionization chambers, scintillation counting-tube and Wilson chamber, solid-state device, bubble chamber. But the most procurable and prevalent method for monitoring radiation situation is Geiger-Muller counting tube, which allows to register the elementary particles and electromagnetic rays.

Radiation has no colors, no smell and can be detected only by special devices. This work is devoted to the method of registration of elementary particles by Geiger -Muller counting tube.

As it is known, effect of radiation was invented by Becquerel in 1896 year. Radiation is spontaneous emission of elementary particles which cause the electromagnetic rays. There are three radiation components: alpha-, beta – and gamma -rays. Alpha rays represent the flow of nuclei helium, beta rays represent a stream of fast electrons and gamma rays represent electromagnetic rays. Beta and gamma rays are more dangerous. Quantity of radiation for people is 5 mSv in years.

Registering apparatus is macroscopic system, which is in unsteady condition. Depending on purposes and conditions of experiments, different register apparatus is used. Register apparatus are notable for efficiency factor, minimum time of register, sensibility.

Geiger-Muller counting-tube is one of the most important devices for automatic counting of elementary particles. Action of device based on impact ionization. Geiger-Muller counting- tube is mainly used to detect electrons and gamma rays.

That laboratory setup is made of modules such as supply equipment, voltage switch converter, impulse counter, acoustic relay, pulse former.

A natural radiation background and radiation of materials were investigated by Geiger-Muller counting tube. Materials ware tested at a distance of 0.1 meters from Geiger-Muller counting tube. The experiments were conducted at different times of day. The more deviations from natural radiation background showed materials such as granite, obsidian, rock from the mine, coal, pyrite in coal .This is due to the fact that those materials are found at greater depths of the earth, where level of radiation is high.

№	Material	Quantity of impulse 1/min., without a natural radiation background
1	Granit	9
2	Obsidian	8
3	Rock from the mine	7
4	Coal	7
5	Pyrite in coal	6
6	Pumice-stone	4

Table №1.Investigation of radiation materials.

During the experiment, there were researched materials of different thickness. As radioactive preparation was used needle of Wilson chamber. Materials such as plumbum, ferrite in metal, graphite, glass, water, soap, hard wax, bronze, steel, foam plastic have a low level of absorbency. This is because those materials have high density and properties.

№	Material	Thickness, mm	Quantity of impulse 1/min., without a natural radiation background
1	Plumbum	3,3	5
2	Ferrite metal	3	6
3	Graphite	12,5	7
4	Glass	4	8
5	Water	15	10
6	Soap	15	12
7	Hard wax	35	12
8	Bronze	0,6	16
9	Steel	0,4	24
10	Foam plastic	30	127

Table №2. Absorbency materials of different thickness.

In the experiment, were used materials such as ceramic tile, wood, linoleum, cardboard and plastic. By increasing material thickness absorbance was increased.

So in conclusion, despite the fact that there are similar devices, modular laboratory setup was made in order to conduct investigation of radiation. Results of research match with results were published in the book. Also handheld indicator was made, which allows taking subsoil in different places of a town for investigation.

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Problems of commercial gasoline production during the process of zeoforming

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Many researchers are engaged in problem of getting a motor fuels that meet the modern requirements from primary products, on the basis of GOST 51866 – 2002 [1]. This is due to the need for more rational use of available resources in the country, the lack of high –quality and affordable motor fuel, as well as the struggle for environmental improvement [2].

Currently, the European Union (EU) and the United States of America (USA) identifies the key requirements for motor gasoline until 2010, which are presented in Table 1. Major changes are associated with a decrease in the sulfur content, aromatic hydrocarbons (primarily benzene) and olefins in gasoline.

Table 1 – Requirements of EU countries to gasoline [4]

Data	Values in different periods of time, year	
	2005 – 2009	2010
1	2	3
Sulfur content, ppm	50,0	10,0
Content,%:		
Aromatic hydrocarbons	35,0	25,0
Olefins	18,0	15,0
Benzene	1,0	0,7
Oxygen	2,7	2,7
The volume fraction of vaporized gasoline,%:		
at 100°C	46,0	46,0
at 150°C	75,0	75,0

To preserve the traditional markets, domestic refineries should produce commercial gasoline, which satisfies its quality characteristics with international standards.

On July 1, 2002 enacted the State Standard of the Russian Federation GOST R 51866 – 2002 “Motor fuel. Unleaded petrol. Specifications”, which is adapted under taken in the EU environmental programs and standards for motor vehicle emissions. Table 2 presents the main indicators of the quality of gasoline in Russia.

Table 2 – Key indicators of the quality of gasoline in Russia [1]

Data	GOST R 51866 – 2002
1	2
Octane number (ON) (Research Method (RM)) / Octane	95/85

Data	GOST R 51866 – 2002
Number (Motor Method (MM))	
Sulfur content, ppm	150
Content,%, not more:	
Aromatic hydrocarbons	42
Olefins	18
1	2
Benzene	1
Oxygen	2,7
Saturated vapor pressure, kPa	45 ÷ 60
The volume fraction of vaporized gasoline,%:	
at 100°C	46 ÷ 71
at 150°C	75

The importance of developing new catalysts and processes to obtain gasoline with high octane number is relevant in connection with a reduction in consumption of leaded gasoline and tighter requirements for the content of aromatic hydrocarbons, especially benzene.

Also very important to expand the resource base of this process by engaging in the production of motor gasoline standard custom of hydrocarbons, such as gas condensate, condensate associated gas and so on, which is especially important for the Russian regions remote from industrial centers of oil and hydrocarbon resources have their own materials [3].

Deactivation of catalyst coke is a reason for the decrease selectivity and drops octane number of produced gasoline is also a key aspect of the technology of catalytic processes, which determines the overall their efficiency.

The main perspective of Zeoforming process is that:

– Low operating costs and capital investments;.

– Simplicity of the technology;

– Less explosive – and fire dangerous for lack of hydrogen;.

– Low sensitivity to the catalyst composition and quality of raw materials.

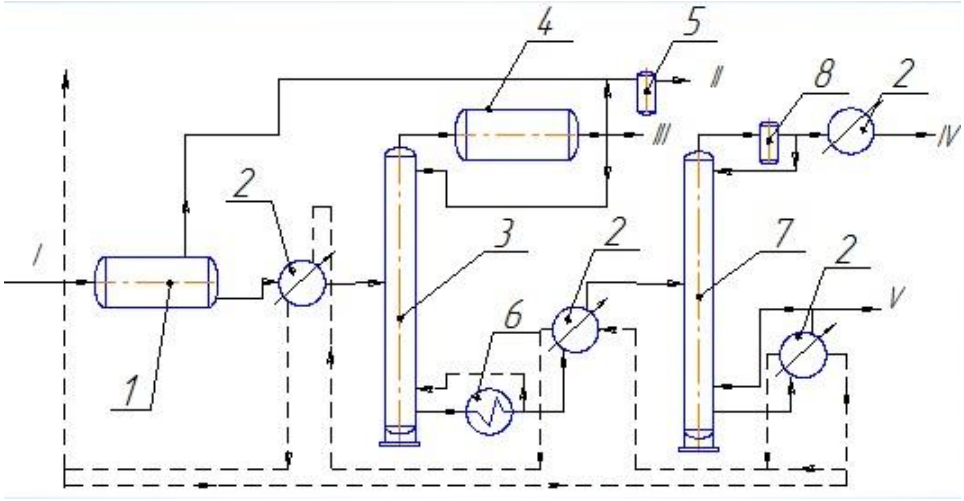
These reasons make the process more cost – effective to implement. The main reaction of this process can be present in the table 3.

Table 3 – The main reactions on zeolite catalysts

Reactions
C_8H_{18}. → $C_5H_{12} + C_3H_6$. ; C_8H_{18}. → $C_5H_{10} + C_3H_8$
$C_6H_{12} \longrightarrow C_6H_{12}$
5 C_3H_6 → $C_6H_5CH_3 + 2\ C_3H_8 + C_2H_8$. ; 3,75 C_4H_8 → $C_6H_5CH_3 + C_6H_{14} + 2\ CH_4$. ; 2,5 C_6H_{12} → $C_6H_5CH_3 + C_5H_{12} + C_2H_6 + CH_4$
$C_4H_8 + C_4H_{10} \longrightarrow C_8H_{18}$
$C_6H_6 + C_2H_4 \longrightarrow C_6H_5C_2H_5$
$2\ C_8H_{10} \longrightarrow C_7H_8 + C_9H_{12}$
$C_6H_6 + C_6H_4(CH_3)_2 \longrightarrow 2C_6H_5CH_3$
$(CH_3)_2\ S \longrightarrow C_2H_4 + H_2S$

At moderate temperatures occur deep conversion of n – paraffin and naphthenes into high – octane gasoline components iso – paraffin and aromatic hydrocarbons. On this type of catalyst takes part and other reactions such as aromatisation, disproportionation, and so on.

The aim of this work is determined the optimal parameters of the fractionation unit with a varying composition of catalysate. The main limitation: the fractional composition of the gasoline product should be close to the requirements of GOST 51105 – 97 [1]. To achieve this aim mathematical model of fractionation unit was designed with help of the program HYSIS. Schematic diagram of a fractionation is shown in Picture 1.



Picture – Schematic diagram of a fractionation unit: 1 – separator; 2,9,10 – heat exchanger; 3 – stabilization column; 4 – condenser; 5 – unit for collecting hydrocarbon gas; 6 – heating furnace; 7 – distillation column; 8 – reflux tank of gasoline vapors; I – warmed feedstock; II – hydrocarbon gas; III – liquefied gas; IV – petrol; V – bottom product.

Pressure had the most significant effect on the composition of the desired product in the columns of the fractionation unit. For example, varying the parameters of the stabilization column leads to changes in the temperature of the beginning and end of the boiling mixture and in the rectification column the boiling temperature of 10 %, 50 %, 90 % fractions is changed. The optimal parameters equipment of the fractionation unit are shown in table 4.

Table 4 – Characteristics parameters of equipment and their products

Technological parameter	Temperature of reaction			
	395	425	445	465
Stabilization column				
Top pressure, MPa	2,67	2,42	2,74	2,18
Distillation column				
Top pressure, MPa	0,92	1,18	1,40	1,36
Gasoline fraction				
Yield, kg/h	611,20	785,60	936,30	904,60
Diesel fraction				
Yield, kg/h	1755,80	1683,10	1588,10	1589,60

With increasing pressure, the temperature in the column is also increased. Parameters, such as a minimum irrigation and / or the temperature on the trays, should be changed when the error occurred. Table 5 shows the fractional distillation catalysts obtained at different catalyst activity, and compositions of the desired product, corresponding optimal parameters of fractionation unit.

Table 5 – Comparison of the fractional composition of the catalyst before and after fractionation

Boiling. range	GOST 51105 –97	Temperature of reaction							
		395		425		445		465	
		Catalyst	Petrol	Catalyst	Petrol	Catalyst	Petrol	Catalyst	Petrol
T_{sb},°C	≤30	36	26,2	37	27,7	37	26,8	38	23,3
10%	≤70	64	27,8	65	33,6	76	30,5	68	25,3
50%	≤120	112	129,0	116	115,4	119	115,8	109	120,4
90%	≤180	187	144,3	171	140,6	167	139,7	145	136,0
T_{eb},°C	≤205	261	155,7	261	152,7	271	152,1	242	145,1

The following conclusions may be made:

1. When the temperature increases, the output of commercial gasoline grows, the yield of the heavy residue and gases falling;

2. Significant changes of the process will produce a commercial gasoline, regulated by the state standard;

3. As for fractional composition that meets the requirements [1] it is not sufficient to change only one parameter, and we need to research all the factors that complicate the task.

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Pharmaceutical nuclear waste disposal

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TREATMENT AND DISPOSAL METHODS.

The bulk of waste falls into the category of general waste, much of which can be recycled or reused. With correct segregation, less than 5 per cent of the waste is likely to be classified as clinical waste.

Clinical waste must be managed by approved treatment methods. Once treated by a process acceptable to the relevant State or Territory authorities, it may be reclassified accordingly before recycling or disposal.

The waste treatment options currently available have various capabilities and limitations. As technology changes, health care establishments should evaluate treatment alternatives for their safety, effectiveness, environmental impact, costs, and compliance with relevant State or Territory licensing requirements. Large volumes of liquids (such as 24-hour urine collections) should generally be disposed of into an appropriate sluice. Precautions must be taken

to avoid the hazards of splashing. Empty disposable containers may be disposed of as general waste, whereas non-disposable containers must be rendered safe for the intended reuse. Body fluids, particularly blood and fluids visibly contaminated with blood, should be treated with caution. Bulk blood and suctioned fluids may be disposed of into the sewer, but care should be taken to avoid splashing, which may cause health risks. A suitably experienced and trained person should carry out this procedure. The disposal of large volumes of blood into the sewer is subject to approval from the local sewerage authority.

There are special circumstances when a known infected material requires extra precautions, such as specific handling procedures required before waste removal from a microbiological laboratory. Moreover, community expectations for responsible clinical waste management require treatment of the waste before landfill disposal. Pathogenic microbiological cultures transmissible by the aerosol route should be rendered sterile by an approved treatment method before they leave the control of laboratory personnel. For special precautions regarding disposal pathways of waste from cases of viral haemorrhagic fever and other quarantinable diseases, eg Ebola or Lassa fever, refer to the relevant State or Territory legislation. In addition, AS/NZS 2243 – Safety in Laboratories details risk groupings of micro-organisms by type and Section 5 provides advice on degrees of hazard associated with various micro-organisms.

Any treatment option for clinical and related wastes should:

- render sharps incapable of causing penetration injury;
- render the waste unrecognisable;
- achieve a significant volume reduction;
- result in residues being suitable for approved landfill disposal without harmful leaching to the environment;
- result in minimum levels of hazardous or toxic by-products, including organochlorines, as approved by the relevant authority;
- reduce the potential for the transmission of infection;
- be verifiable for the treated wastes;
- have automatic controls and built-in fail-safe mechanisms;
- have continuous automatic monitoring and recording;
- ensure that the waste cannot bypass the treatment process;
- meet occupational health and safety standards;
- have fail-safe alternative treatment and disposal in case of emergency;
- provide pre-treatment refrigerated storage facilities as licensed; and, where feasible, implement materials and energy recovery strategies; and.
- in the case of autoclaves, be tested at least annually to ensure that optimal performance is maintained.

Waste treatment and disposal methods currently approved in Australia include:

- autoclaving;
- chemical disinfection.
- grinding/shredding (sodium hypochlorite).
- grinding/shredding (hydrogen peroxide and lime);
- landfill;
- microwave;
- regulated incineration;
- encapsulation; and.
- sewerage (as determined by relevant authorities).

Details on some of the treatment options follow.

Autoclaving.

Autoclaving involves the heating of infectious waste by steam under pressure. The effectiveness of autoclaving depends on the temperature, pressure, exposure time and the ability of steam to penetrate the container. Confirmation that the required temperature has been reached is imperative.

Noise emissions can be of concern with an autoclave and should be considered in design and siting of the equipment. The energy costs for steam production could be high. Trained staff are required to ensure proper operation. Autoclaving can produce offensive odours, which require proper ventilation to satisfy the relevant State or Territory air emission standards. Autoclaving does not change the physical form of visually offensive waste.

Condensate and blow-down liquids may contain sufficient contaminants for the effluent to be classified as hazardous. Excessive liquid contained by autoclaved waste can make the surrounding working area constantly wet. This seepage problem persists all the way to the final site of disposal. Autoclaving can be used for the bulk of clinical and related wastes. Care must be taken to exclude body parts, pharmaceuticals, including cytotoxics, and radioactive wastes. Autoclaved waste can be disposed of by landfill, provided that approval has been obtained from the relevant State or Territory authorities.

Incineration.

Incineration is a term used commonly to describe all systems of burning, although only one standard is considered to be effective. In these national guidelines ‘incineration’ is used to describe the process of combustion carried out in a multiple-chambered incinerator that has mechanisms for closely monitoring and controlling the combustion parameters.

Combustible waste can be incinerated provided that an appropriate incinerator is used. Incinerator residues can generally be disposed of in landfills. However, if the residues contain considerable heavy metal contaminants, the relevant State or Territory disposal codes of practice or legislation must be followed. Where incineration is used, the following issues should be addressed. Emission standards: Depending on the types of waste incinerated, gaseous emissions may involve toxic gases such as hydrogen chloride, nitrogen oxides, sulphur oxides, dioxins and furans. Regular maintenance of any incinerator is therefore essential to efficient operation. This will ensure that the appropriate emission requirements are met as well as minimise the long-term total running costs. Ash disposal: A well-designed and -operated incinerator will destroy any infectious and toxic waste by exposing it to a sufficiently high temperature for a sufficient time, with sufficient oxygen to burn organic matter, leaving a biologically inert ash with no combustible residue. There should be no recognisable plastic, paper or fabric in the ash. Care should be exercised in the removal and disposal of incinerator ash:.

• it should be wetted for a sufficient time before handling to minimise the potential for generating airborne dust and any fire risk;.

• the amount of water used in wetting the ash must be controlled, because excessive water in the ash may enhance leachate generation in landfill;

• all personnel handling the ash should wear face masks fitted with dust filters, heavy gloves and protective clothing as a safety precaution;

• the removal of incinerator ash should be mechanised, and be designed to facilitate continuous or semi-continuous operation of the incinerator; and.

• the ash should be stored in enclosed containers and transported to anapproved landfill site for supervised burial.

Flyash collected from particulate control devices may have high concentrations of heavy metals. It may need special disposal treatment.

The fire box, or domestic incinerator, is a single chamber in which combustion is usually incomplete and involves uncontrolled temperatures. It is therefore unsuitable for the incineration of clinical and related wastes and its use is no longer permitted.

Approved incineration is suitable for all types of clinical and related wastes, excluding radioactive wastes.

Landfill.

Landfill is a traditional disposal method for waste. Some landfill sites used in the past are unsatisfactory for disposal of clinical or other wastes because leaching can contaminate ground water or public access is not controlled. If clinical and related wastes have been carefully segregated, most of the material can be safely landfilled.

Clinical and related wastes constitute a very small proportion of the total waste stream directed to landfill (less than 1 per cent) and, when managed correctly, are no more dangerous in the landfill environment than domestic waste.

Where clinical and related wastes are disposed of by landfill, the site must be confirmed as suitable. A physically contained (engineered) site is preferable where movement of leachate is controlled.

Public access to the point of disposal of clinical and related wastes should be restricted during the active disposal period. The owner of the waste or their agent, who is trained to deal with the waste, must deposit the material at the lower edge of the working face of the landfill or in an excavation, and supervise immediate covering of the waste to a depth of one metre. (This does not apply to the general waste component of the waste stream). Soil or other solid waste may be used as cover. The recommended depth of one metre aims to prevent scavenging and accidental recovery of the waste.

The landfill site operator should sign appropriate documentation completed by the transporter. The transporter should hold proof of proper disposal.

Where landfill disposal of clinical and related wastes is intended, recognizable anatomical parts, pharmaceuticals and cytotoxic waste should be excluded at source. Landfilling of liquid wastes is not permitted. Consult State or Territory regulations for approved landfill disposal of clinical and related waste residues.

Sewerage.

Disposal of certain liquid wastes to sewer may be acceptable because the associated potential hazards are reduced through dilutions and dispersals within the sewerage system. Disposal to sewer must meet occupational health and safety guidelines. Bulk blood and suctioned fluids may be disposed of into the sewer, but care should be taken to avoid splashing, which may pose health risks. A suitably experienced and trained person should carry out this procedure. The disposal of large volumes of blood into the sewer is subject to approval from the local sewerage authority.

Approval should be obtained from the relevant authorities before any discharge of large amounts of fluid waste into the sewerage system. Sewerage is not a suitable disposal method for solid clinical and related wastes, pharmaceuticals including cytotoxics, or radioactive wastes.

Microwave.

The microwave process usually involves the grinding and shredding of waste materials to optimise radiation exposure. Water is sprayed onto the waste, which is then moved by an auger through microwaves generated by a series of microwave power packs. Volatile materials and water are driven off by heat generated during the process. The resulting waste is a relatively dry granular material suited to landfill.

Microwaving is suitable for the bulk of clinical and related wastes, excluding body parts, pharmaceuticals including cytotoxics, and radioactive wastes.

Chemical disinfection.

Chemical disinfection, which includes physical maceration (shredding or grinding) is a suitable treatment for small amounts of clinical and related wastes. This treatment usually involves an initial grinding/shredding of the waste, which is then soaked in a liquid disinfectant. Agents used include sodium hypochlorite, and hydrogen peroxide and lime.

Subject to the approval of the relevant State or Territory authorities, the spent liquid can be discharged to sewers and the solid residue can be disposed of in a landfill.

Chemical disinfection is not a suitable treatment method for human body parts, pharmaceuticals including cytotoxics, or radioactive wastes.

Other treatment options.

Other technologies include:

- plasma arc torch;
- continuous-feed autoclave;
- pyrolysis and electro-oxidation;
- dry heat sterilisation involving quartz infrared treatment; and.
- radiation.

As technologies are continually being updated and developed, institutions should be open-minded with respect to their waste disposal options.

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Automatic system for commercial accounting of power consumption

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According to the purpose ASCAP can be divided into two types: the systems of commercial accounting and technical accounting systems.

The commercial accounting – records electricity consumption (as well as gas, water, etc.) for cash settlement for her supplier. Accounting for such devices requires high accuracy.

The technical accounting processes are required to control energy consumption within the enterprise, all its enclosures, workshops, energy installations. Analysis of the statements technical accounting system gives business a number of opportunities to reduce energy consumption and power without impacting on production.

Operational-measuring by the method of collecting and processing information, these systems can perform statistical and operational-measuring functions. Statistical ASCAP performs the function of collecting and processing information for certain time periods, which is produced on the basis of analysis and calculations for consumed energy sources. Operational-measuring functions of ASCAP allows to conduct real-time tracking modes of consumption and quality of energy. This it applies not only electricity; but any type of energy – gas, steam, water, thermal energy [3].

The benefits of implementing automated systems ASCAP are as follows:

- rational energy consumption and increase in energy efficiency;

- ability to use different tariffs for the electricity consumption;
- automated data processing, storage and presentation of data in user-friendly mode;
- construction of multi-level systems and the ability to transfer data to other levels of the system;
- possibility of operational data in a convenient mode for analysis;
- ability to obtain information remotely via the Internet;
- control and protection from criminals [3].

Disadvantages refer to greater complexity of data collection and technical impossibility of applying meters with pulse output.

Modern computerized accounting system consists of three levels:

1. Measuring. It comprises measuring means and performs a function of measurements (low level). Elements of this level are instruments that measure various parameters of the system. These devices can be employed will various sensors.
2. Binding. It includes wardrobes data collection and transmission and a function of transmitting information about this property or group of objects (medium);
3. Data collection and storage. It includes data collection center or information-processing complex (computer, controller or server) (high level) [3].

Data collection can be carried out through various communication channels. Choice of communication channels, as well as communication equipment carried out on the stage of research and design. ASCAP supports the following types of channels: RS 232/485, PLC modems, Internet, GSM, GPRS, radio modems (433 MHz), FM radio, DSL modems, etc. As workstation user uses a PC-compatible computer, server database and server survey also use PC-compatible computer. It is possible to spread the polling server and database server on different equipment [2].

The key aspect of ASCAP selection is the quality and security of communication between levels, as well as the economic issue. Providing reliable, efficient and inexpensive delivery system that will provide reliable and secure transmission and data exchange, between consumers and suppliers of energy is crucial choice of power supply systems [1].

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Risk assessment

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This article is concerned with the assessment of economic risks and suggests new methodology.

A risk assessment is a process of identification and detection of potential hazards with further analysis of the consequences of hazards. A business impact analysis is the process

for determining the potential impacts resulting from the interruption of time sensitive or critical business processes [1].

Identification of the whole life assessment of the economic, environmental and risk performance of new network assets is critical for making investment decisions. Thus, it is essential to understand and assess possible future liabilities that occur from potential hazards.

Risk assessment is the process that includes the following stages:

- Identification of hazards.
- Analysis or evaluation of the risk associated with these hazards.
- Determination of appropriate ways to eliminate or control the hazards.

In practical terms, a risk assessment can be defined as a thorough look at your workplace to identify those things, situations, processes that may cause harm, particularly to people. After identification is made, it is possible to evaluate how likely and severe the risk is, and then decide what measures should be taken to prevent effectively or analyze the caused harm [2].

Methodology

Life-cycle assessment (LCA, also known as life-cycle analysis, ecobalance, and cradle-to-cradle analysis) is a technique to assess environmental impacts associated with all the stages of a product's life from-cradle-to-cradle (i.e. from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling). LCAs can help avoid a narrow outlook on environmental concerns by:

- compiling an inventory of relevant energy and material inputs and environmental releases;
- evaluating the potential impacts associated with identified inputs and releases;
- interpreting the results to help make a more informed decision [3].

Cost Categories

There are a lot of different factors that the whole life assessment depends on, such as historic failure rates, vulnerability, weighting factor, exposure and hazard zones etc.

There's one more factor that the whole assessment depends on. It's a cost.

Cost is usually a monetary valuation of effort, material, resources, time and utilities consumed, and risks incurred. All expenses are costs.

As costs occur from a lot of different sources, with varying degrees of certainty, accuracy and methods of quantification, they are divided into five groups. These groups describe the general source and significance of the costs assigned. The whole-life cost categories are:.

Type I – Direct costs (e.g. capital investment, labour costs, raw materials and waste disposal and etc.);.

Type II – Indirect or "hidden" direct costs(e.g. operational or site overhead costs not assigned to a single asset or project such as electrical losses);.

Type III – Contingent future costs and liabilities (e.g. compliance costs, fines, compensation payments or costs associated with unplanned maintenance, failures and other catastrophic events);

Type IV – Internal intangible costs (such as impact of asset failures on market share, staff morale and reputation as a result of the project success or failure);.

Type V – External intangible costs (e.g. impact on the environment both locally and globally, or the impact on society, e.g. cost of carbon that could be internalized in the future i.e. carbon trading) [4].

Asset Policy Studies: Cable Tunnel Co-location

This case study was used to inform decision-making on the potential life time costs, and the benefits or otherwise associated with co-location of 400kV transmission and 132kV dis-

tribution cable lines, in comparison with single owner/occupier tunnel systems for each cable type.

The functional units for comparison were:

1. 1 x 3m tunnel for 132kV cables (a DNO perspective);
2. 1 x 3m tunnel for 400kV cables (TSO perspective);
3. A combination of the two 3m tunnels;
4. 1 x 4m tunnel for co-location (regulator encouraged position).

It was found that there is a short-term capital investment saving and a long-term whole life cost saving, and significant environmental benefits, from the adoption of a 4m diameter co-located cable tunnel facility rather than the combined 3m diameter cable tunnels costs.

The economic benefit of the 4m co-location cable tunnel in regard to total Type I to III costs, covering all direct, indirect and contingent liability costs, is equivalent to a saving of between 26% and 36% over the combined 3m tunnel modal cost. When the intangible internal and external Type IV and V costs are also accounted for, the overall economic benefit of the 4m co-location cable tunnel spans a saving of 11% to 27% with respect to the combined 3m tunnel modal cost.

However, the level of additional co-location risk must however be carefully considered, particularly in regard to cable circuit operational factors such as thermal management, cable current ratings and also the possibility of cable joint failures and tunnel fires.

Conclusion

The new methodology for whole life costing and risk assessment of assets provides a powerful and insightful integration of assessments associated with economic and environmental risks. It is a very useful an assessment of the risk of technology selection, operation and management, overall policy and health and safety issues [5].

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Mechatronic device objectives

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1 INTRODUCTION TO MECHATRONICS.

Mechatronic is a term coined by the Japanese to describe the integration of mechanical and electronic engineering. More specifically, it refers to a multidisciplinary approach to product and manufacturing system design [1]. It represents the next generation machines, robots and smart mechanisms for carrying out work in a variety of environments predominantly factory automation, office automation and home automation as shown in figure 1.1(a) [3].

As a discipline, mechatronic encompasses electronics enhancing mechanics (to provide high levels of precision and reliability) and electronics replacing mechanics (to provide new functions and capabilities). Some examples where mechanics has been enhanced by elec-

tronics are numerically controlled machines tools which cut metal automatically, industrial robots and automatic bank tellers.

The products where electronics replaces mechanics include digital watches, calculator or others. However, the products that really blur the distinction between electronics and mechanics are machines and robots driven by numerical control [2].

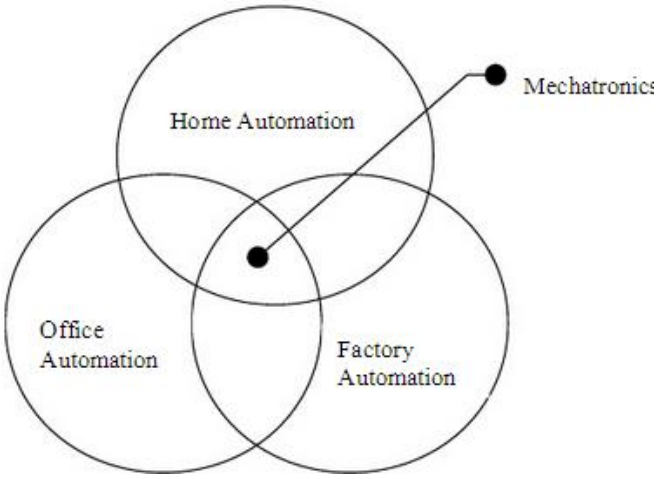

Figure 1.1 (a): Domains of mechatronics.

Japan is the first country in the world to have mastered the NC machines technology and as a result the Japanese machine tool industry has flourished. This is because the Japanese have mastered mechatronics, the fusion of precision mechanics and electronics in design, engineering and manufacturing, which are popularly depicted by the Japanese as shown in figure 1.1(b) [3].

2 SCOPE OF MECHATRONICS.

Since the 1970s, there has been a dramatic change in the technology of these products, mainly an increasing content of electric and electronic systems integrated with the mechanical parts of the products, mechatronic. Example of products which have already moved to mechatronic technology from simple mechanical products are [4]:

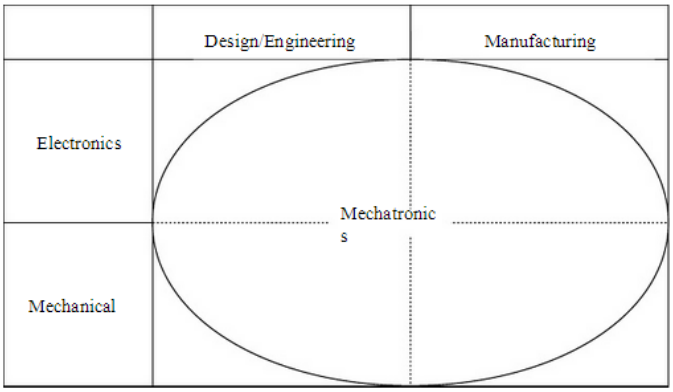

Figure 1.1(b): Concept of mechatronics.

a. Machine tools incorporating computer numerical control (CNC), electric servo drives, electronic measuring systems, precision mechanical parts, such as ball screws, antifriction guide ways and each other's.
b. Electronic watches incorporating fine mechanical parts and complex electronic circuits.
c. Electronic consumer products – washing machines, electronic cooking appliances, fax, plain paper copiers and others.

In the last twenty years, the production technology has seen the introduction of high precision measuring instruments such as electronic gauges and measuring instruments, in process gauge and quality control instruments, laser measuring systems and others to ensure high dimensional accuracies, as well as increased productivity on the shop floor.

In the domain of factory automation, mechatronics has had far-reaching effects in manufacturing and will gain even importance in future. Major constituents of factory automation include NC machines, robots, automation systems and computer integration of all functions of manufacturing. Proper application, utilization and maintenance of these high technology products and systems is an important aspect that enhances the productivity and quality of products manufactured by the customers. To ensure correct selection of equipment, an accurate estimation of the techno-economics of various manufacturing systems, developments in the high technology machines and equipment are studied in detail. Also, proper maintenance

of various mechatronic elements, diagnostics can increase the life of the various mechatronic elements, which in turn will enhance the life of the product or system. Such inputs in mechatronics can be best given by the manufacturers of hi-tech machines and manufacturing systems. In fact, the machine tool manufacturers are now being called upon to offer a total manufacturing for solution in production, by the customers, rather than supply of just the stand-alone machines. This trend is already evident in many of the advanced countries. Evidently, the design and manufacturing of future products will involve a combination of precision mechanical and electronic systems and mechatronics will form the core of all activities in products and production technology.

3 TYPES OF MECHATRONIC DEVICES.

The types of mechatronic devices is used such as switches, relay, solenoid, power diode, power transistor, thyristor, gate controller switch, rectifier, chopper, transducer and others [5].

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Nanotechnologies in the Electrical Energy Sector

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Nanotechnology is an interdisciplinary field of basic and applied science and technology, which deals with the accumulation of theoretical basis and practical methods of investigation, analysis and synthesis, as well as methods of manufacture and use of products with a given atomic structure by controlled manipulation of individual atoms and molecules.

Nanotechnologies are worldwide regarded as key technologies for innovations and technological progress in almost all branches of economy. Nanotechnologies refer to the target-oriented technical utilization of objects and structures in a size in the range of 1 and 100 nm. They are less seen as basic technologies in the classical sense with a clear and distinct definition, since they describe interdisciplinary and cross-sector research approaches, for example in electronics, optics, biotechnology or new materials, using effects and phenomena which are only found in the nano-cosmos.

Nanotechnologies provide the potential to enhance energy efficiency across all branches of industry and to economically leverage renewable energy production through new technological solutions and optimized production technologies. In the long run, essential contributions to sustainable energy supply and the global climate protection policy will be achieved. Here, nanotechnological innovations are brought to bear on each part of the value-added chain in the energy sector.

Low-Loss Power Supply through Nanomaterials.

Considerable progress was made in the development of high-temperature superconductors in the last years through the production of yttrium-barium copper oxide (YBCO) on me-

tallic carriers (so-called Coated Conductors, CC), which significantly extended the processability and applicability of this material class. Cable lengths of over 600 m could already be realized. Superconductors will play a growing role in energy technology for low-loss wired power supply, in coil windings and bearings of electric engines as well as in residual current circuit breakers in high-voltage grids. The most important challenge is the production of all deposited layers (superconducting and buffer protection layers) by chemical means from low-cost precursor to decrease costs to an economically attractive value. Nanotechnologies provide toeholds for the control of the microstructure in layer formation, for example through specific insertion of nanoparticles in the form of particle inclusions in the lattice structure. Currently, superconductive nanostructured systems from sol-gel precursors are being developed in a project supported by the German Federal Ministry of Education and Research (BMBF). In the long run, cables of carbon nanotube composites as high-efficient conductors could be an alternative for a low-loss power supply line in high-voltage grids. This, however, would require further significant progresses with regard to more efficient production methods and technologies for the production of long CNT-fibers with uniform structure.

Nanostructured Insulation Materials for High-Voltage Power Lines.

Efficiency of power transfer in high-voltage power lines increases with increasing amperage. In Europe, current is usually conducted at approx. 400 kV, while in extensive countries like China and India high-voltage grids with up to 1500 kV are aspired. Due to increased voltages and the required current compaction as a result of the feeding of decentralized power generators and the supply of huge metropolitan areas, the electrical and mechanical strains on high-voltage power lines are growing. Hence, a central task of high-voltage technology is the further development of electric insulation systems, for example through the application of nanomaterials. The material design on the nanoscale enables the optimization of electric insulation properties like breakdown voltage, for example, through the application of nanostructured metal oxide powder in varistors as protection elements against overvoltages in power lines. Multifunctional, non-linear and auto-adaptive insulation systems are in development, the mechanical and electrical properties of which change with field strength, temperature or mechanical stress and adjust optimally to the power demand.

Nanotechnologies within Smart Grids.

The worldwide increasing liberalization of the electricity market will significantly increase the future demand on the flexibility of the power grids. Trans-European power trading requires efficient energy distribution even over long distances, a flexible adjustment to temporarily strongly fluctuating demands and a quick controllability of the power flow to limit the extent of grid failures and the risk of extensive blackouts. The existing power distribution grid encounters limits even regarding the growing decentral power supply from fluctuating renewable sources. The future power distribution requires grids which enable a dynamic load and failure management as well as a demand-driven energy supply with flexible price mechanisms. Nanotechnologies could contribute essentially to the realization of this vision, for example through nanosensoric and power electronic components, which could cope with the extremely complex control and monitoring of such grids. Here, miniaturized magnetoresistive sensors on the basis of magnetic nanolayers provide potentials to enable an area wide online-metering of current and voltage parameters in the grid.

Efficient Application of Wireless Nanocrystals.

Use of wireless technologies refers to the perspective trends characterizing the modern stage of the scientific and technological development. In particularly, the tendency is rapidly

evolving in the energy sector involving energy distribution and transmission, and nanotechnologies provide solutions to a variety of urgent problems in this area.

A wireless nanodevice that functions like a fluorescent light – but potentially far more efficiently – has been developed in a joint project between the National Nuclear Security Administration's Los Alamos and Sandia national laboratories. The experimental success efficiently causes nanocrystals to emit light when placed on top of a nearby energy source, eliminating the need to put wires directly on the nanocrystals.

The energy source is a so-called quantum well that emits energy at wavelengths most easily absorbable by the nanocrystals. The efficiency of the energy transfer from the quantum well to the nanocrystals was approximately 55 percent – although in theory nearly 100 percent transfer of the energy is possible and might be achieved with further tweaking. The work is another step in creating more efficient white-light-emitting diodes – semiconductor-based structures more efficient and endurable than the common tungsten light bulb.

Reduction of lighting costs is of wide interest because on a world scale, lighting uses more electrical energy per year than any other human invention. Nanocrystals pumped by quantum wells generate light in a process similar to the light generation in a fluorescent light bulb.

There, a captive gas permeated by electricity emits ultraviolet light that strikes the phosphor-coated surface of the bulb, causing the coat to emit its familiar, overly white fluorescent light. The current work shows that the nanocrystals can be pumped very efficiently by a peculiar kind of energy transfer that does not require radiation in the usual sense. The process is so efficient because unlike the fluorescent bulb, which must radiate its ultraviolet energy to the phosphor, the quantum well delivers its ultraviolet energy to the nanocrystal very rapidly before radiation occurs.

Because the emissions of nanocrystals (a.k.a. quantum dots) can be varied merely by controlling the size of the dot rather than by the standard, cumbersome process of varying the mix of materials, no known theoretical or practical barriers exist to pumping different-sized quantum dots that could individually emit blue, green, or red light, or be combined to generate white light.

The quantum well, about three nanometers thick, is composed of a dozen atomic layers. It coats a wafer two inches in diameter and is composed of indium gallium nitride. The film is not fabricated but rather grown as crystal, with an energy gap between its different layers that emits energy in the ultraviolet range at approximately 400 nm.

In this proof-of-principle work, the energy in the quantum well was delivered with a laser. Although the difficulties of inserting energy into the quantum well using an electrical connection rather than laser light are significant, it is considered to be feasible.

So, In view of a globally increasing energy demand, threatening climatic changes due to continuously increasing carbon dioxide emissions, as well as the foreseeable scarcity of fossil fuels, the development and provision of sustainable methods for power generation belong to the most urgent challenges of mankind. Massive effort at political and economical level is required to basically modernize the existing energy system. Growing efficiency and new methods through nanotechnological know-how may play a key role for the required innovation in the energy sector.

Nanotechnological components provide potentials for the more efficient utilization of energy reserves and the more economical development of renewables. Nanostructured insulation materials are to be implemented in smart grids and, as a result, they will contribute to the dynamic load and failure management as well as a demand-driven energy supply with

flexible price mechanisms. Introduction of wireless nanocrystals is seen as a productive step in creating more efficient white-light-emitting diodes that will allow to reduce lighting costs.

To sum up, the design of a future energy system requires new long-term investments in research activities based on realistic potential assessments and careful adaptation of the individual supply chain components based on cutting-edge nanotechnologies.

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Panfilov, N.S.

Poisoning the reactor with Samarium

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There are two types of poisoning the reactor Fission poisoning and liquid poisoning. The first type is natural and the second one is manmade. The liquid poisoning type is used to prevent the accidents in the reactor and to decrease the consequences. But in this presentation we will consider the fission poisoning (referred to as poisoning).

Poisoning the reactor – the process of formation short-lived products of fission in the working reactor, which involved in unproductive capture of neutrons and thereby lowering the reactivity margin in their accumulation and increasing it when they decay.

Slagging of fuel – is the process of accumulation stable and long-lived fission products in the working reactor which involved in unproductive capture of thermal neutrons and thus lowering the reactivity margin reactor.

The element Samarium-194 is a strong slag of the first group. Its half-life is 13,84 years, it means that it's almost stable. But why do we say about poisoning rather than slagging the reactor?.

Yes, Samarium is a slag but its accumulating in fuel elements of the reactor has some peculiarities which make the process of changes in Samarium concentrating similar in quality to poisoning the reactor with Xenon. In difference to other slags, Samarium can not only be accumulated in a working reactor but can be bombarded by neutrons. Thus, losses of reactivity connected with Samarium accumulating can be either increased or decreased due to its intensive bombarding at high levels of the reactor power. That's why the process of Samarium accumulating was named poisoning rather than slagging.

Samarium isn't practically formed as a product of fission in the reactor. In this case almost all its formation is connected with beta-decay of another product of fission – Promethium-149. This element as a direct fragment of fission is also formed in small amounts. A basic source of its formation is beta -decay of Neodymium-149. Thus, the processes of formation and decreasing fission products can be shown as following.

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Petrusev, A.S.

Increase of effectiveness of solar batteries by using of solar tracker and acryl concentrator

National Research Tomsk Polytechnic University.

Currently in Russia there is an acute problem of the lack of cheap electricity in the areas with decentralized electric power supply. Now that area is embracing about 70 % of the country with a population of 20 million people [1]. Currently stand-alone diesel systems use allowы to get only a very expensive electric power, which in some towns costs under 56 rubles per kW·h and above. It is therefore very important in such areas to use autonomous renewable energy sources, which include solar energy. Now solar power engineering development is progressing at a rapid speed – 30% per year. In 2013 the solar power plants of total power about 30 GW were put into operation, whereas the total power in 2012 was 102 GW. In addition, taking into account the purity and the prevalence of renewable energy sources, solar energy is one of the most promising. But at the present moment solar power plants have two weighty drawbacks, delaying their mass distribution. The drawbacks are the high price of solar cells and relatively low efficiency of conversion the solar energy into electric energy during the entire day.

The aim of this work is to search the appropriate methods of increasing the efficiency of solar energy conversion into electric energy and to develop the experimental sample of the installation.

The high price of solar power plants is determined primarily by high cost of photocells per kW of electric power. If the efficiency of photocells is increased using, for example, instead of single-crystal cell (efficiency 15-17%) gallium arsenide cells (efficiency 30-35%), the cost is increased many times (about 40 times) – from about 2,5$ to 100$ per kW, respectively. Therefore it is more promising not to increase the efficiency of photovoltaic cells, but to amplify the incident solar energy since the output power of photocell is almost directly proportional to the incident solar energy. There are 2 ways to do this: to orient the solar panel on the sun by using a solar tracker or to concentrate solar energy by using a solar concentrator.

Solar concentrator is a device that allows to collect solar energy from a larger area and direct it to a smaller area. Now solar concentrators are mainly represented by parabolic mirrors and Fresnel lenses. There are also other various mirror systems with different degree of concentration, but they are not widely used due to various weighty drawbacks. Parabolic mirrors are very large and heavy because of their design, which does not allow to make them smaller. Hence the system is subjected to an increased risk of breakage. The mirrors also require very precise orientation to the sun and powerful cooling systems, otherwise their efficiency is extremely reduced. Fresnel lenses have a smaller, but still substantial thickness, and also require more precise orientation and more powerful cooling. Moreover they are quite expensive.

In the present work a unique acrylic solar concentrator that solves the problems mentioned above is proposed. Fig. 1 schematically shows a cross section of the acrylic solar concentrator. It corresponds a plate of plexiglass with thickness about 1 cm, consisting of a special reflective surface and two wedges. The inclined planes of the wedges are directed opposite to each other and have a gap between them filled with a special glue. The concentrator developed allows to collect solar energy by entire receiving surface and direct it into the end faces where the photocells are placed. This occurs due to calculated and exactly matched refractive indices in the concentrator’s medium, as well as the angles of the wedges and the edges of reflective surface.

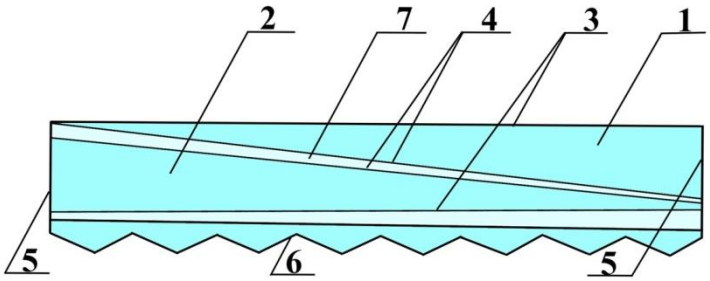

Fig. 1 (left). Cross-section of acrylic solar concentrator.

The principle of operation of the solar concentrator is based on the phenomenon of total internal reflection. Sunbeams, falling on the working surface 3 of the optical wedge 1, are partially reflected, and the rest, undergoing refraction at the interface penetrate inside the wedge. Depending on the refractive index of the wedges' material, optical medium 7 and the wedge angle, the sunbeams trapped in the wedge 1 either are reflected from its surface 4, or pass through it and optical medium 7 inside the wedge 2. The optical medium 7 has a refractive index smaller than the refractive indices of the optical wedges 1 and 2. Due to the effect of total internal reflection of the sunbeams reflected from the surface 4 of the wedge 1 fall ultimately on the base 5 of the optical wedge 1. The sunbeams which have passed through the optical wedge 2, penetrate through its operating surface 3 and fall on light deviating element 6, which reflects the sunbeams back into the optical wedges 1 and 2. Light deviating element 6 is performed so that the sunbeams reflected from it enter the wedges 1 and 2 at the angles providing their total internal reflection within the wedges with a further incidence of light on the end faces 5 of the wedges.

Since the relation between receiving surface area of one wedge end face of the solar concentrator is as 1 to 14, 7-fold concentration of solar energy with efficiency of 75% is achieved. The efficiency is calculated theoretically and confirmed experimentally. The concentrator has a small weight and size, large directional pattern on the sun and does not require powerful cooling systems, allowing to use only passive radiators.

The calculations of the efficiency of the solar concentrator subject to the angle between the concentrator surface normal and the line of sunbeams falling are carried out by ZEMAX software. It was found that it works effectively in the range from –3 to –0,1 degrees on one axis and from –30 to 30 degrees on the other. Therefore for the orientation only one plane is needed. However, under such conditions, a solar tracker which performs a movement of at least one axis is required.

Solar tracker is a device directing solar panel or solar concentrator to the sunbeams, allowing to produce more energy during the day. Trackers are divided into active, passive and manual. The most versatile are the active orientation systems, as they are able to operate automatically, as well as to find the most actively radiating light source, and not to rely on prepared movement program. The trackers can be oriented either by one axis or by 2 axes. Although the two-axis orientation gives a small gain compared to a single-axis one, it is quite complicated and more expensive [2]. Therefore, in terms of given geographical location, unique single-axis active solar tracker is proposed. Its principle of operation is based on the analog-digital signal of control board, which avoids the use of microcontrollers and stepper motors, allowing to reduce the system total costs and to simplify it, maintaining quality and reliability.

The formula of the dependence between the power that reaches the photocells and the angle of sunbeams incidence on the solar panel is derived. The tests which confirm the dependence obtained were carried out.

The solar battery was installed in the initial position perpendicular to the incidence of the sunbeams with a help of a tube in which there was a longitudinal through hole (the orientation took place before the occurrence of bright luminous point under the tube). Then, using

the pyranometer installed the same way the amount of total solar radiation incident on 1 square meter perpendicular to the line of sunbeams incidence was measured.

After that the solar panel power was calculated by measuring its current and voltage at different angles of incidence between the normal to the photovoltaic module and the line of sunbeams incidence. The angle of incidence was regulated using a specially designed rack. The photovoltaic module fixed on the rack could take stable positions with increments of 15 degrees. Three measurements for each angle were carried out. The arithmetic mean values of the measurements was recorded in the table and noted on the curve of the solar panel power-angle of incidence.

As a result, it was found that the points of the graph and the theoretical curve obtained are almost completely coincided. Slight variations are due to the fact that the measurements were not instantaneous, but within a ten minute period of time. The radiation power within the period can vary. The accuracy of the orientation to the sun and measuring instruments are also the factor of variations occurred.

Further calculations showed that without tracker solar panel loses about 40% of electric power during the day [2].

The model of reduced scale, demonstrating the principle of operation of solar tracker, was designed and assembled.

Main components are:

- Battery powering the motor and the external circuit (1);
- Control board that regulates the rotation of the installation (2);
- Motor performing rotation (3);
- Limit switches (4), which not allow the solar panel to rotate for more than 180 degrees, preventing wire break;
- Solar cell (5), fixed at an angle of 45 degrees to the horizontal, which charge the battery;
- Switch (6), which enables or disables the system;
- Output jacks (7), connected to external circuit, allowing to supply some electrical equipment.

Limit switches correspond two boards fixed near the shaft which rotates the solar panel. Their principle of operation is based on optocoupler principle. When the metal plate is placed between the light emitting diode (LED) and photodiode the output current stops to flow in the specified direction. This allows to turn off the tracker when it reaches a certain critical angle.

The main part of the installation is the control board. Its principle of operation is based on 2 LEDs, arranged at an angle of 40 degrees relative to each other. Sensors for the control board are LEDs and not photodiodes. Due to the fact that the principles of their operation are similar in many respects, the LEDs can be used instead of more expensive photodiodes.

When photons of light hit the LEDs' n-layer the electrons are knocked out. Most of them are recombined due to the fact that they cannot overcome the much wider p-n junction than that in photodiodes. Nevertheless, a small number of electrons still overcome it. The potential difference occurs and current begins to flow, which is amplified by means of transistor amplifier installed in the board.

When the solar radiation falls more on one of the diodes of the board, the control signal is generated. The signal enables the electric motor to rotate the entire installation.

Important feature of this board is the ability to adjust the step of tracking system. By changing the resistance of potentiometer used in the board it is possible to change the time between the solar tracker operations from a few seconds to several hours. This is essential due to the fact that the sun moves around relative to a solar panel slowly and continuously whereas switched on solar tracker consumes an excessive electric power. Therefore it is

more efficient to put the solar tracker into operation for definite time intervals. The dependences of the system's power on the orientation step were calculated. They showed that the most efficient system must have the orientation step of 1 hour for solar panels and 8 minutes for solar concentrators.

The calculations of efficiency increase of solar panels with tracker were carried out. For example in Tomsk region during the most bright and warm days, the power of total solar radiation reaches a peak at 1100 W/m^2, and in the cold winter indicator drops to 150 W/m^2. The graph of the total solar radiation for August 14th, provided by the site of atmospheric composition climatology of Tomsk region was taken [4] (on the 14th of August, it was about the average value of solar radiation between summer and winter). The data on azimuth and zenith of the sun in the Tomsk region on August 14th were also provided.

The results of the calculations in the form of dependences of output power on time are represented in Fig. 5. The curve 1 corresponds to the solar panel with solar tracker, the curve 2 – without it. It may be concluded that when the orientation system is used the output power is substantially higher than that for static solar panel, excluding the interval from 13 to 14 PM, when the sun is in the south.

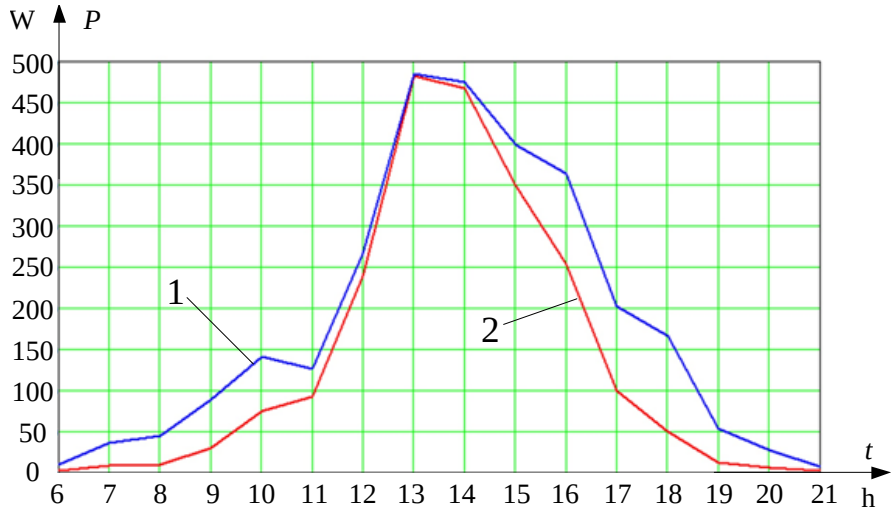

Fig. 5 (left). Dependence of output electric power produced of orientable solar panel (1) and static solar panel (2).

According to the results obtained by calculations the use the solar tracker can increase the efficiency for 30-35% for solar cells and several times for the solar concentrators. Solar concentrator and tracker simultaneous application reduces the cost of solar power by more than a factor of 2 for monocrystallic solar cells and 4-5 times for gallium arsenide solar cells.

The laboratory installations of the solar concentrator (1 W) and solar tracker (10 W) were created. The work on scaling the samples, as well as on the possibility of replacing the acryl by polyester in solar concentrator is currently carried out.

Conclusion.

On the example of Tomsk region it is proved that solar power plants use for autonomous electric power supply objects is efficient. Therefore, among the known ways the methods of azimuth orientation of solar panels during the day are considered and implemented. Furthermore, in order to increase efficiency it is proposed to use the acrylic solar concentrator. The result of the work is the photovoltaic installation, which contains the photovoltaic modules and the original control system.

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Pleshkov, A.N., Stolyarova, A.K.

Experimental study of biomass drying softwood

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The topic of my scientific work is «Experimental study of biomass drying softwood».

The purpose of my work is Experimental determination of the evaporation rate liquid in the softwood biomass.

In recent years in the world there is a greater interest in using of biomass for heat and electricity, its involvement in the fuel and energy balance of the regions and countries on the whole. This is proved by numerous studies in the European Union and the United States, aimed at identifying the best ways of using biomass energy, as well as in Russia .The interest in using biomass is defined by the following main factors: Environmental, associated with the need to address, including global climate problems. It's necessary to reduce the consumption of non-renewable energy sources (gas, oil, coal), actively exhaustible in the nearest future, and to replace them with the renewable sources. The biomass use is one of the radical solutions of the problem to reduce the greenhouse gas emissions (CO2) power plants using fuel, as well as to reduce the emissions of other harmful ingredients: trees and plants that make up the main part of the biomass themselves absorb CO2 emissions: how much CO2 is absorbed, so much produced by burning and does not increase by a concentration in the atmosphere; practically there is no biomass virtually sulfur, low nitrogen and ash content.

The work relevance.

Examining and analyzing the literature a has been found that insufficiently reliable experiments must be conducted by the experiments in this direction.

The practical significance.

Analysing and developing are the optimum parameters of drying softwood biomass, in order to increase savings in non-renewable energy sources, as well as the funds spent on their prey Improving the impact of the heat production.

How biomass is formed.

The atmosphere carbon dioxide and soil water by means of participating in the photosynthesis process to produce the carbohydrates forming the biomass "building blocks". Thus the solar energy used in the photosynthesis has stored in chemical form in the biomass structure. If we burn the biomass efficiently, the extract chemical energy, the atmosphere oxygen and the carbon contained in plants react forming the carbon dioxide and water. The process is cyclic because the carbon dioxide can once again participate in the production of a new biomass.

Biomass energy application.

The biomass taking the sixth reserves among the currently available energy sources besides the oil shale, uranium, coal, oil and natural gas . Approximately complete biological

land mass is estimated at $2,4 \cdot 10^{12}$ tons. Biomass is the fifth performance of the renewable energy source besides the direct solar, wind, hydro and geothermal energy. Every year, on the ground are produces about 170 billion tons of primary biomass and about the same amount is destroyed. The biomass is the largest by using of the world economy in a renewable resource (more than 500 million tons at . (Tons per year) The biomass is used to produce heat, electricity, biofuels, biogas (methane, hydrogen) .The main part of the biomass fuels (80%), is primarily the wood, used for heating and cooking in developing countries.

The examples of using biomass.

In 2002, the U.S. electric power was installed 9733 MW of the generating capacity the biomass use. 5886 MW of them worked at the waste of Agriculture and Forestry, 3308 MW worked at municipal solid waste, 539 MW from other sources. In 2003, 4 % of all the U.S. energy was produced from biomass. In 2004, the worldwide electricity was produced from biomass power plants with the total capacity of 35,000 MW. Currently, The European countries are experimenting growing the energy forests for the biomass production . On the large plantations have been grown fast-growing trees : poplar, acacia, eucalyptus and others. Tested about 20 species of plants. Plantations can be combined when the trees are grown between the rows of other crops, such as poplar, combined with barley. There is a energy forests rotation for 6-7 years.

Boilers for biomass.

The Biofuel boilers successfully combine the advanced automation, the heat exchangers and the modern convenience dignity with the unique pellets . The pellets themselves have been compressed under a high pressure from a small wood waste or vegetation. No artificial additives in their manufacture have been applicable.

Conclusion.

When burning there are absolutely harmless products, as well as a natural and pleasant smell . The remained ash after it can be used as a fertilizer in your garden . Thus the environmental cleanliness is one of the important characteristics of biofuels.

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Implementation of a solar-diesel power plant in decentralized area of the Republic of Altai

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More than 16 million residents in Russia refer to the decentralized power supply. Human need for electric energy is doubling every 10-15 years. Stand-alone sources of energy are used in the territory with decentralized power supply. In the paper it is considered an example of the Republic of Altai, which uses one of the first in the world solar-diesel power plant. Until that time, a diesel power plant has operated for many years.

Villagers of Yailu are provided with electricity only sixteen hours a day. It is associated with the limited capacity of the diesel power plant, rate issues and difficulties with the purchase and transmission of fuel. Solar-diesel power plants represent a new solution to the problem. That combines energy of the sun and diesel generation.

The solar-diesel power plant was built in a short time, in the period from November 2012 to March 2013. The project was implemented within the framework of a state contract of Ministry of Education and Science of Russia on creation pilot projects in the field of solar energy, implemented in the framework of the Federal Target Program «Research and development on priority directions of scientific-technological complex of Russia». At a power plant was installed equipment from leading manufacturers. On the one hand, this project was a scientific research. On the other hand, it provides continuous power supply for one of the most remote areas of the Republic.

Power plant implemented in the Republic of Altai consists of: diesel engine and alternator (made in Japan) – device which generates electricity via fuel combustion; solar panel (made in Japan) – converts solar energy into direct current; inverter (made in Germany) is device that converts direct current to alternating current, and change, voltage and frequency; battery (made in China) is used for energy storage; controller (made in Turkey) monitors the battery charge. Made by «SMA», «YANMAR», «DATAKOM Electronics Limited» and others.

Solar-diesel power plant has a number of advantages:

1. Safer for the environment.
2. No need to connect to the centralized power grid.
3. Fully stand-alone system.
5. Long service life.
6. Reducing diesel fuel consumption.
7. Power plant operates 24 hours a day.
8. Reducting the cost of electricity.

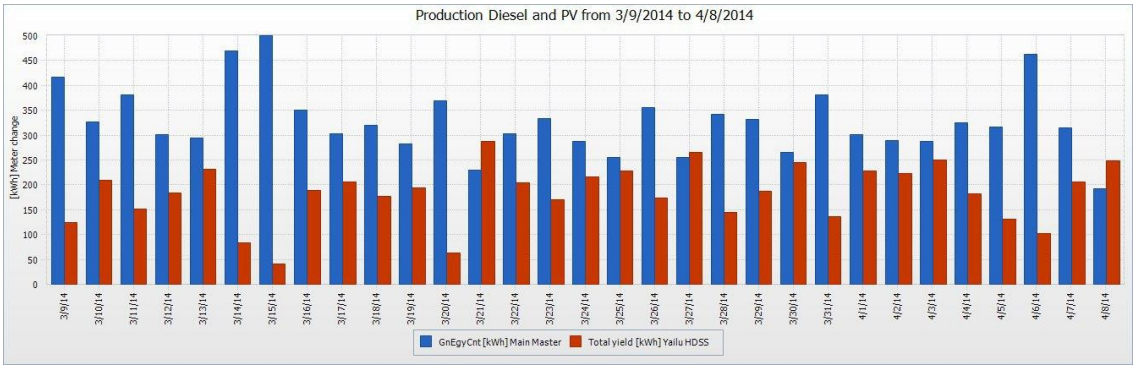

Figure 1 – Diagram of the production of electricity solar – diesel power plant.

Solar-diesel power plant has several of disadvantages:

1. The need to accumulate energy produced by solar modules.
2. High construction costs associated with the use of trace elements (indium and tellurium).
3. The need for periodic maintenance.

Hybrid power plant in the Republic of Altai is able to provide reliable, stable power supply for remote areas (See Figure 1).

Operating solar-diesel power plant has reduced by 50 percent the annual consumption of diesel fuel and saved 1.8 million rubles.

Developers are going to continue the experiment. Such power plants should be built in areas with high level of diesel generation. These are Yakutia, Tuva Republic, Transbaikal territory, Far East. It will lead to reducing budget expenditures.

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Rudnik, V.Ye., Ryndin, I.A., Obskov, A.V.

New prototyping of Google Corp. will travel in Global Business: Google Glass

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In our day and age, technology is omnipresent and an integral part of our live. However, although the main purpose of technology is to make our life easier, the reactions and opinions on technology are very diverse. Every people would like to make our life easier. Google glass can solve this problem. It is absolutely new design from Google. You can see the world more colorful. For example, you may capture all that happened during the day. Walking down the street, you often look into your smartphone and it may be dangerous for your health: you can stumble and fall. With Google glass you forget about it. Interaction with user happens by voice commands. Some words helps you enter the Internet, use map, and check weather. As a result, Google glass includes three main functions: augmented Reality, mobile telephony+ Internet, video diary [1].

Touchpad: A touchpad is located on the side of Google Glass, allowing screen. Sliding backward shows current events, such as weather, and sliding forward shows past events, such as phone calls, photos, circle updates, etc. Camera: Google Glass has the ability userstocontrolthedevicebyswipingthroughatimeline-likeinterfacedisplayedontheto take photos and record 720p HD video. While video is recording, the screen stays on while it is doing so. Display: The Explorer version of Google Glass uses a Liquid Crystal on Silicon (LCoS), field-sequential color, LED illuminated display. The display's LED illumination is first P-polarized and then shines through the in-coupling polarizing beam splitter (PBS) to the LCoS panel. The panel reflects the light and alters it to S-polarization at active pixel sites. The in-coupling PBS then reflects the S-polarized areas of light at 45° through the out-coupling beam splitter to a collimating reflector at the other end. Finally, the out-coupling beam splitter (which is a partially reflecting mirror, not a polarizing beam splitter) reflects the collimated light another 45° and into the wearer's eye [3].

Technical specifications it is based on Android 4.0.4 and higher, 640×360 Himax helloHX7309 LCoS display5-megapixel camera, capable of 720p video recording, Wi-Fi

802.11b/g, Bluetooth, 16GB storage (12 GB available), 682MB RAM, 3 axis magnetometer (compass).

Ambient light sensing and proximity sensor.

Voice commands (Base command: “ok glass”, after that, you must say real command), gestures, recognized by touchpad and audio system with bone conduction [1].

Some voice commands: «ok, glass, recordavideo.», «ok, glass, takeapicture.», «ok, glass, google [search query].», «ok, glass, google photos of [search query].», «ok, glass, send a message to [name].», «ok, glass, send [name] that [message].», «ok, glass, how is the weather in [place]?».

Device Interface was demonstrated in video, February 2013. In March Google used exhibition to show first applications for the Glass. Currently the company is working over the sample for people with bad vision [2].

So whether technology is aiding our life and making it easier, or creating new challenges and stress for us, really depends on how we react and interact with the new technologies. If -- when technology solves one of our problems -- we keep immediately coming up with new, larger problems, no technology will ever be able to satisfy our constantly new needs. However, if we allow technology to make our life easier, and focus more on the quality, rather than the quantity of life, and also learn how to use technology to our greatest advantage -- such as how to use it to influence others -- we can all greatly benefit.

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Economic efficiency of the transition from conventional to renewable power engineering

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At the beginning of the XXI century world consumption of energy exceeded 500 EJ/year (1 EJ = 1018 J) or about 12 billion year. According to various forecasts by 2020 world power consumption will increase more than by one and a half times. Requirement of the population increase with increase in the population. In the conditions of gradual exhaustion of cheap stocks of organic fuel opportunity full and with acceptable expenses of satisfaction of growing energy needs causes serious fears. The nuclear power after a number of serious accidents on the nuclear power plant yet doesn't cause trust of the public. Besides, energy consumption by mankind makes only about 2/10000 total receipts of energy of sunlight on Earth surface. At the same time, in comparison with the energy going for processes of photosynthesis (about 40 TVt), the world power is commensurable and, by estimates, reaches about 20% of it that points to basic possibility of noticeable global influence of power on the biosphere. The power is responsible approximately for 50% of all harmful anthropogenous emissions in environment, including greenhouse gases[1].

Mankind for a long time I am familiar with renewables. Such types, which, in process of human size not exhaustible, ecological pure both an economic favorable electric and thermal power source. Renewables are the sun, a wind, oceanic inflow, warmly terrenewabltrial

depths and chemical energy. These types of nonconventional types of energy would become the solution of everything of problems in energy drinks, economy and human wants. In 1981 in the city of Nairobi (Kenya) Conference of the UN at which the world action program on use new and renewables was accepted Took place[2].

As we know from school physics every body has a lot of energy and we also know that the energy is not lost and it does not disappear just move from one to another form of energy. In such way we understand energy not probably to destroy or spend. Energy is in the nature, and our task to transform them in necessary to us a type of energy. Staff of the Ariston company showed one of these examples having presented on the market wall coppers for heating and hot water supply with efficiency of 107%. She allows to use the hidden energy which contains in combustion gases, i.e. transforms on the energy necessary to us. The person has a lot of opportunity to receive energy from the nature. Question in that that, what potential at nonconventional sources of an enegriya and what economic benefit? Whether will be able, renewables to replace traditional sources?.

Potential of the renewables (R) on the indication experts, are very great. For example, the development of renewable energy in Russia is 4.6 billion tons of fuel, which is more than four times the current energy consumption.

This is a very large sum, and shows high potential for renewable energy. But, at the same time makes you wonder if such a high potential of renewable energy, why, world level of introduction of Renewabl makes only 20%, and plans to raise to 2020 to 24% and by 2050 to 50%. Thus the share of renewables in electricity production should reach 38.6%, the heat – 14% biofuel – 13.2%. And why is it such a big country as Russia, which is 70 % of its territory with a population of about 20 million people located in the area of decentralized power is not transferred to the non-conventional sources of energy. According to various estimates, ensuring through alternative sources composes from 25 to 50 % of energy consumption. On the one hand, this eco-friendly best sources . With the help of renewable energy could reduce the serious disadvantages of conventional energy sources . Since Earth is a large house shared humanity, the use of renewable energy would affect the safety of Environmental Activities, improve human health and economic stability. But despite all this, the development of renewable energy occur very slowly[3].

Above the told UN Conference in 1981 has been created experts Commission . After 10 years, a group of UN experts analyzed the state of affairs in the energy sector and using a lot of materials around the world, has assessed the environmental impacts of different types of alternative energy sources . The overall conclusion of experts suggests that the existing notion of renewabl as a completely environmentally friendly sources erroneously . And since then this look is object of research . And till today revealed some shortcomings of Renewabl. The disadvantages primarily relates that renewabl are characterized, as a rule, a small energy flux density :

<u>solar radiation.</u>
on a clear day – 1000 W/m2.
in an average year – 150-250 W/m2.

<u>wind flow.</u>
at v = 10 m / s – 500 W/m2.
at v = 5 m / s – 60 W/m2.

<u>water flow.</u>
for v = 1 m / s – 500 W/m2.

In traditional power installations density of power streams reaches hundred kW or even several MWt/sq.m. As a renewablult, need for big surfaces for collecting energy and need of use of big accumulators of energy that causes cost growth. Collecting, transformation and management of power streams of the small density, in some cases having daily, seasonal

and weather instability, demand considerable costs of creation of receivers, converters, accumulators, regulators, etc [2].

Renewabl forces to create the big areas of power installations "intercepting" a stream of used energy . It leads reception surfaces of solar installations, the area to a big material capacity of similar devices, therefore, to increase in specific capital investments in comparison with traditional power installations. However, increased investment subsequently recouped by lower operating costs, but in the initial stage they beat sensitive afford those who want to use renewable energy.

As for "free of charge" the majority of types of Renewabl, this factor is leveled by considerable expenses on acquisition of the corresponding equipment. Some paradox, consisting that the rich countries though more developing countries need it are capable to use free energy, mainly, renewablults, but owing to the poverty have no funds for acquisition of the necessary equipment. The rich countries as Russia, don't show power hunger and show interenewablt to alternative power engineering for reasons of ecology, energy saving and diversification of power sources[3].

Therefore large-scale application of renewabl is a problem which demands system approach which is shown in many countries, and substantially – through legislative base.

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Solar power towers

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The solar power tower, also known as 'central tower' power plants or 'heliostat' power plants or power towers, is a type of solar furnace using a tower to receive the focused sunlight. It uses an array of flat, movable mirrors (called heliostats) to focus the sun rays upon a collector tower (the target). Concentrated solar thermal is seen as one viable solution for renewable, pollution-free energy.[1].

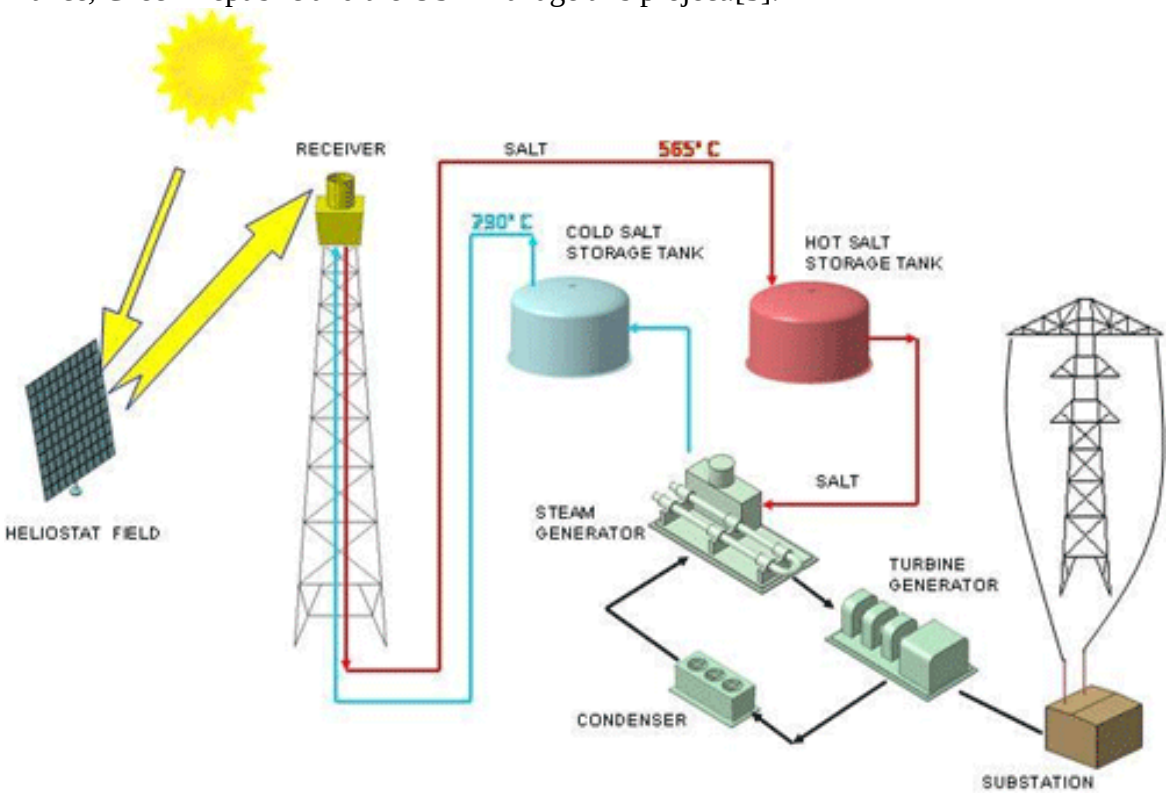
Picture 1, The 11MW PS10.

One of the most known towers is The 11MW PS10 near Seville in Spain. Because of strong bright light dust and moisture glow in the air, and we can see rays. On the field there are 624 mirrors, each is 120 square meters and the height of the tower is 115 meters. To build this station costs 33 million euros and it occupies several square kilometers. But the output energy can provide electricity to 6000 houses.

Sun rays turn water to steam.Steam is heated to 500 °C to drive turbines that are coupled to generators which produce electricity. Such towers use direct high temperature chemical reaction such as liquid salt. Thus, we can make the transformation of water. This method allows to accumulate energy in big tanks with hot salt and a plant can work in cloudy weather. It can provide steam generator's working for 16 hours without sun and it also can work all night long.[2].

There are other solar power towers, for example, in the USA, Turkey, Spain, Germany. There was a project of building SolarTres for 15 MW in Spain too. The project aims at building a tower with 2493 mirrors, each of which is 96 square meters.

In the second picture we can see the structure of this plant. Pink –is a storage of hot salt, blue – is a storage cold salt, red – is a steam generator which is connected with the turbine and the condenser. The European Commission has allocated 5 million euros for this construction. The International organization SolarPACES with the companies from Spain, France, Czech Republic and the USA manage this project.[3].



Picture 2.

Different solar power towers have differences in their structure, because everyone wants to make the production of energy more effective and cheaper. For example, Solucar in Sanlúcar la Mayor try to use various technologies such as parabolic concentrators with Stirling engines and parabolic cylindrical mirror with pipes for heating the coolant.

The price for erection of these plants is high and its energy is expensive, but due to the development and improvements in this sphere it will be cheaper. Also such manufactures

have positive influence on the environment. In the nearest future they will prevent the emission of near 600,000 tons of carbon dioxide per year.[2].

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EUROSTAG: power system dynamic simulation for transient, mid and long term stability

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EUROSTAG® is a software developed by Tractebel Engineering GDF SUEZ and RTE for accurate and reliable simulations of power systems dynamics.

It is dedicated to the dynamic simulation of the power systems, and fulfils the following three basic requirements. First, a single software program to simulate fast and slow phenomena in a continuous way. Second, for any phenomenon, a performance at least equal to those of the specialized software programs. Third, faster and easier studies.

EUROSTAG is based upon a unique algorithm using a continuously and automatically varying integration step size, featuring:

– A unique program using unique modelling of processes for a whole range of applications,
– A continuous display for both fast and slow phenomena.

EUROSTAG integrates all power system components and actions necessary to produce an accurate and faithful dynamic simulation: Generators – Motors – Controllers – Protection devices – Control equipment.

The advanced dynamic functions of EUROSTAG allow for the full range of transient, mid and long-term stability to be covered thanks to a robust algorithm using an auto-adaptative integration stepsize. The differential and algebraic equations are solved simultaneously with a variable integration time step. The stepsize varies automatically according to the actual behavior of the system (typically from 1 ms to 100 s) in order to secure a constant accuracy of the calculation process. In fact, the truncation error is calculated at each step for the determination of the exact step length to be used.

Open to import and export data in various international formats, the software is also renowned for its flexibility. Indeed, the user can directly access a vast library of power system models or modify them using a flexible graphical modelling language.

Various manoeuvres and operations can be initiated at predetermined momenta or during the simulation by user intervention. This is made possible by the graphic monitoring of the changes of the system's main quantities.

EUROSTAG can read the data in international formats and can recover models and parameters used in older programs, allowing knowledge acquired with other tools to be saved. It goes further in result exploitation through export to specialized programs (Microsoft Office, Matlab).

The following operations can be carried out:

- opening and closing circuit breakers Seven if a separation or resynchronization occurs, the relevant phenomena being simulated);
- shutdown and start-up of generating units;
- shutdown and start-up of induction motors;
- switching loads and compensation means on and off;
- transformer tap-changer operations;
- changes in set-points of controllers.

In order to help you understand and analyse in depth all your critical system phenomena, EUROSTAG software embeds the following calculation tools:

- Load Flow computation: system analysis in normal steady-state situation, the starting step to any power system study.
- Application Program Interface (API): allows for the integration of the power of EUROSTAG dynamic simulation engine into an external process through Matlab, Python, C or C++ code.
- Critical clearing time calculation: automatic determination of the faults clearing times to avoid instabilities on power systems.
- Full-scope dynamic analysis: dynamic simulation of wide range of incidents, topological modifications or process commands happening in a power system.
- Eigenvalues computation and system linearization: entry points of small signal stability analysis, study of the behavior of the system subject to small fluctuations around an operating point.

In conclusion, with more than 25 years of continuous development, the pioneering dynamic analysis tool EUROSTAG presents the following features:

– *Efficient and powerful algorithm*, able to manage large power systems and enable the simulation of extended scenarios thanks to an auto-adaptive integration stepsize
– *Wide range of applications*, allowing users to solve conventional but also highly complex power system problems (black-out scenarios, voltage collapse…)
– *Flexible and secure modeling*, thanks to its unique editors: File Editor, Model Editor, Network Editor
– *Advanced post-processing*, for both interpretation of results and the editing of reports
– *Open software*, permitting the import and export of various data from international formats
– *Reliable simulations*, due to daily use and continuous improvement over 25 years by world class experts

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Renewable Energy Sources

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Currently in the world there are several large-scale problems. One of them is the depletion of natural resources. There is an increasing demand to use huge amounts of oil and gas. Therefore involuntarily a question arises: how long will fossil fuels last, its use in the same huge volume will go on? According to statistics based on mathematical calculations, the deposits of planet's natural resources will have exhausted by the end of the next century. Thus, future generations will have nothing to use for energy production? No doubt fossil fuels adversely affect the environment around the world. Therefore, mankind is now thinking more about alternative sources of energy to reduce the dependence.

Renewable energy sources (RES) energy constantly exist in natural processes on the planet, as well as energy products, life biocenters plant and animal origin [3].

A special feature of renewable energy is cyclical origin, which allows you to use these resources without time constraints.

Usually, renewable energy sources refer to solar radiation, water flows, wind, biomass, heat of the upper layers of the earth's crust and oceans.

RES can be classified by types of energy [3]:

1. Mechanical energy (wind and water);
2. Thermal and radiant energy (solar radiation and geothermal);
3. Chemical energy (biofuel).

Major opportunities of RES are virtually unlimited because they don’t contribute to the depletion of natural resources, land resources but inadequate use of equipment and technology, lack of the necessary structural and other materials makes it extensive to use renewable energy.

Under certain conditions, in low-capacity autonomous power systems, renewable energy can be economically profitable than traditional resources.

Wind power

Wind power is one of the fastest growing industry in the world markets. Growth in recent years makes 31% of total RES consumptions [2].

Hydropower

Currently, hydropower is more than 60 % of all renewable energy sources and is the most productive one (modern hydroelectric efficiency equals about 85-95 %).

Solar energy

The sun is one of the most important sources of renewable energy. Consequently, energy of the star is increasingly being used by humans for producing electricity. Indeed, solar radiation, amounting to the entire surface of the Earth, has tremendous power of 1.2 kW * 1014, which in turn raises questions about the global use of this type of resource.

Biomass Energy

Biomass includes all substances of organic origin. At the moment, the use of biomass as a source of renewable energy is under development and implementation for mass use.

Prospects for the development of renewable energy in Russia

Wind power.

In the Russian Empire, there were more than 20,000 windmills with a total capacity of 1 million kW.

Evaluation of the use of wind energy resources shows that for energy use of renewable source is suitable about 8 million km^2 area where the average wind speed exceeds 5 m/s. If

humanity used only 1% of the area to set up wind turbines, their installed capacity would exceed 300 million kilowatts [2].

Hydropower

Russian hydropower resources are estimated to be 852 billion kW / h per year. This so-called economic potential is suitable for industrial use. Largest hydropower Russia takes 2nd place in the world.

Distribution of hydropower in Russia: European part – 25%, Siberia – 40% and 35% Far East. Hydropower potential in the European part is used almost entirely.

Solar power

Russia has a huge potential of solar energy. Southern Russia, the Far East and Trans-Baikal have a high level of solar radiation, which is comparable with the southern regions of Europe, where solar energy has already gained intensive development.

Bioenergy

One of the most promising renewable energy resources in Russia is biomass. In the meantime, this source is less involved. However, in fact, approximately 10% of the total world consumption makes timber [1].

Conclusion

Reserves of Earth are depleting, the population is increasing every year, but the demand for electricity is growing.

Today humanity is increasingly using renewable energy opportunities, but out dated equipment and technology, lack of necessary structural and other materials do not allow using widely these resources.

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The current state of alternative energy in post-Soviet Union countries

Alternative energy – is a set of promising ways of generating, transmitting and consuming energy, which are not as widespread as traditional, but are of interest due to the use of profitability and low risk of environmental at pollution.

Kazakhstan.

President Nursultan Nazarbayev said that by 2050 at least half of the total energy consumption must account for alternative and renewable resources of energy.

By 2030, the share of electricity generation in coal-fired power plants will amount to 75 per cent. The share of such energy should make about 10 per cent.

By 2015 it is planned to generate by the alternative sources about 1 billion kilowatt hours.

Share of renewable energy in total energy consumption must be 1.5 per cent by 2015, and more than 3% up to 2020 year.

By 2015, it is planned to construct a wind power plants with installed capacity of 125 Mw to produce 400 million kWh.

Potential maximum of renewable resources is 450 million kWh.

The biggest wind power plants are Selekovskij corridor and Atyrau. with capacity 100 MW.

Dzungarian vorota by wind characteristics is the most promising platform for wind farm construction in the world, but their area is small. The Dzhungar gate will develop a total output of more than 1000 Mw.

It's planned to put into operation about 250 MW of power by 2015, and about 2000 MW by the year 2030.

Main regions of wind power engineering are North and South of Republic.[1].

Ukraine.

The main disadvantage of alternative energy in Ukraine is its high cost compared with traditional energy sources.

However, taking into consideration high environmental parameters today cost of electricity generated by wind power and thermal power stations are the same.

Today Ukraine has commissioned 10 biogas plants with a total capacity of approximately 7 Mw. The rate of "green tariff" for biogas was not approved, but several bills are under consideration. Up to the year of 2020 production rate could achieved at 8 billion cubic meters of biogas.

Advisable to place solar power plants in southern Ukraine.[2].

Armenia.

The main sources of renewable energy in Armenia are considered to be hydroelectric power, followed by geothermal sources, as well as the generation of electricity through wind and solar potential. The energy generated at the nuclear plant makes 40% of the total volume of the country's electricity, gas makes 37% and 23% refer to renewable energy. The most promising area of renewable energy in Armenia is Hydro power. Now the country has got 95 small hydropower stations with a total capacity of 124 Mw, which produce 387 million kwh of electricity. Over the next 10-15 years the number of small hydropower stations is expected to rise up to 164.

Most biggest pow Hydro power plant is Tatev station. Total capacity is 616 MW [3].

Advantages of renewable resources:

1. Inexhaustibility. Proven reserves of oil, gas and uranium may last at least 50 years Wind and Sun resources are unlimited [3].
2. Environmental safety. Solar and wind power don't produce harmful emissions.
3. Cheap maintenance. These plants do not require periodic servicing.
5. Autonomy. You can use away from power lines.[4,5].

Disadvantages:.

1. Low capacity. Installed capacity and efficiency of green power is not comparable with the traditional.
2. Large investments. It requires significant investment and may not pay off.
3. Dependence on external factors. If the wind is gusting, and the sky is cloudy, the effectiveness of green power is low.
4. Significant areas. Windmills and solar panels require large territories [6].

Currently, the share of renewable energy sources is relatively small. But now the construction of wind, solar and hydroelectric power plants, and the development of relevant laws is underway. This will in future considerably reduce the share of non-renewable sources of energy and improve the environment in the countries of the former Soviet Union.

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Synthesis and characterization of ultrafine tungsten carbide in a discharge plasma jet

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1. Introduction

Superhard tool materials play an important role in engineering and manufacturing. The characteristics of these materials are high hardness, strength, thermal stability, wear resistance, corrosion resistance. One of the best known superhard materials is tungsten carbide. It is used in the fabrication of various tools for metal cutting and rock drilling, for the manufacture of armor-piercing bullets and shells core.

At present there are a lot of methods for obtaining tungsten carbide. Tungsten carbide nanopowders are synthesized by electric discharge machining followed by annealing under nitrogen atmosphere [1]. Another method for obtaining tungsten carbide (WC) is a single step synthesis of nanoparticles directly from scheelite ore, which contains tungsten [2]. Tungsten carbide nano-particles are formed by carburizing tungsten/tungsten oxide/non-stoichiometric tungsten oxide particles obtained from a wire explosion process with multi walled carbon nano tubes [3].

Theoretical and experimental data analysis shows that one of the most promising ways is to obtain crystalline phases of nanodispersed tungsten carbide in the gas-phase system using carbon and tungsten powders as precursors. The required P, t-parameters can be obtained in the leading-edge shock wave of the supersonic pulsed carbon plasma jet impinging upon the chamber filled with gaseous nitrogen at the velocity up to 10 km/s.

2. Experimental

Experimentally the above described interaction is achieved with a pulse (up to 500 ms) high-current (about 10^5A) coaxial magneto-plasma accelerator (CMPA) with graphite electrodes [4, 5]. Initial mix of carbon and tungsten powders (total weight is 0,75 g with weight ratio W/C=2:1) is loaded into the zone where high-current Z-pinch arc discharge plasma structure accelerated in the coaxial system is formed. The accelerator is powered by a current pulse generator with a maximum stored energy of up to 360 kJ. In the experiment charging voltage is 3 kV and charging capacity is 6 mF that corresponds to 54 kJ of energy. Plasma is shot into the sealed reactor chamber filled with argon gas at normal conditions. The chamber is opened and the synthesized powder is collected after cooling and complete precipitation of suspended particles in the argon atmosphere. As a result, 0,485 g of dark gray powder product is obtained. The untreated synthesized material is examined with X-ray diffraction (XRD) using Shimadzu XRD7000 (CuK_α-radiation) diffractometer and high-resolution transmission electron microscopy (HRTEM) (JEOL JEM 2100F microscope).

3. Results

Figure 1 shows the X-ray diffraction pattern of the plasma-dynamic synthesis product. It is obvious that the obtained material consist of several ultrafine crystalline phases: tungsten W, tungsten carbides W_2C and WC_{1-x} and graphite gC. Phase analysis of the product was

conducted with Powder-Cell and Powder Diffraction File PDF 4 programs. The main phase of the synthesized product is a cubic tungsten carbide WC_{1-x} (more than 95%).

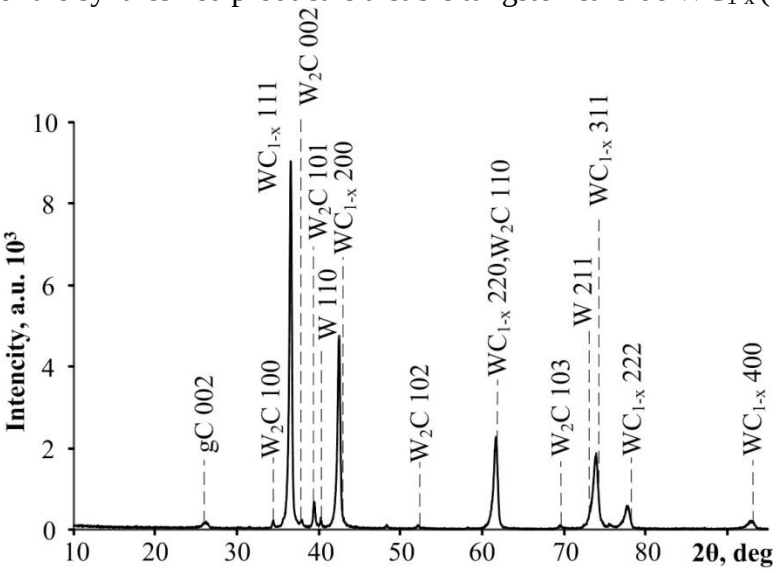

Fig. 1 (left). XRD pattern of the synthesized powder product.

Figure 2 shows the results of the high-resolution transmission electron microscopy of the product. The analysis of HRTEM images shows that the product consists of two types of objects (Fig. 2a). The first one is rounded particles sized up to 120 nm, which might be tungsten carbide phases. The second one is less dense objects, corresponding to nanosised carbon. In the selected area of the electron diffraction (SAED) image (Figure 2c) two diffuse rings (supposedly nano-sized graphite phase) and individual point reflex corresponding to interplanar spacings of tungsten carbide phases can be identified. Figure 2b is HRTEM image of a single tungsten carbide particle sized about 30 nm. The object has a rounded shape surrounded by a shell consisting of nano-sized graphite.

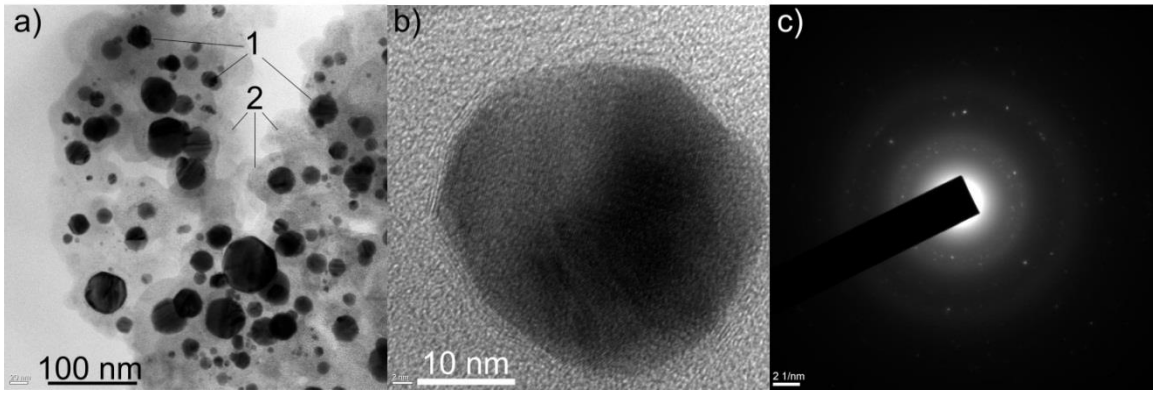

Fig. 2. HRTEM-images of the product: (a) Bright-field image; (b) Lattice image; (c) SAED.

Figure 3 shows the histogram of particle size distribution in the range from 10 nm to 120 nm. Only the first type of objects (tungsten carbide) is taken into account for the particle size distribution histogram. According to the histogram distribution is narrow enough and most particles are sided 10 to 40 nm. The peak of distribution is in the range from 10 nm to 20 nm.

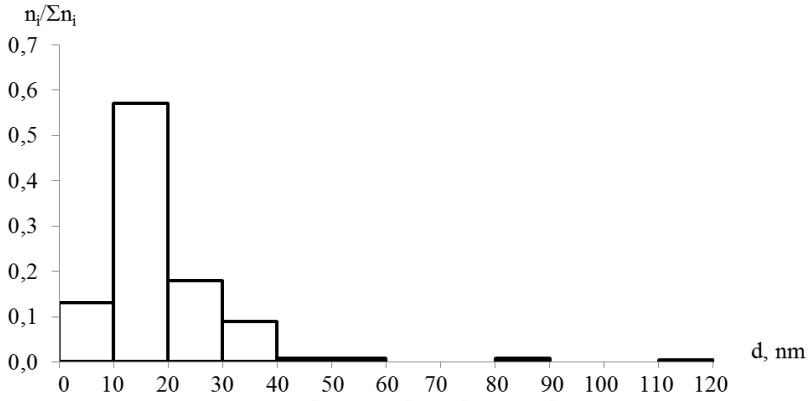

Fig. 3. Particle size distribution histogram.

4. Conclusion

Tungsten carbide is synthesied from the mix of pure tungsten and carbon black with plasmadynamic method using the system based on the coaxial magnetoplasma accelerator. The plasmadynamic synthesis product is composed of tungsten W, tungsten carbides W_2C and WC_{1-x} and graphite gC. The main phase of the synthesized product is cubic tungsten carbide WC_{1-x} (more than 95%). Particles of tungsten carbide WC_{1-x} are sized up to 120 nm.

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Witricity – Wireless Electricity

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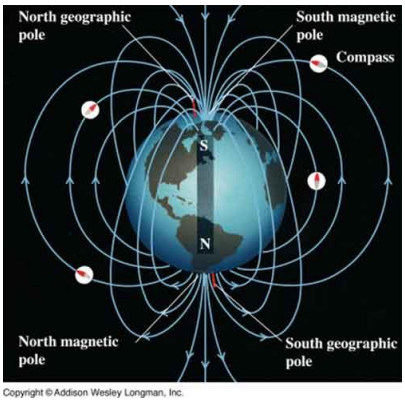
What is WiTricity ?

- WiTricity is nothing but Wireless elecTricity.
- Transmission of electrical energy or power from one object to another without the use of wires is called as WiTricity.
- Because of WiTricity some of the devices won't require batteries to operate.

History of Wireless Power.

- In 1891, Nikola Tesla Proposed a method of Wireless Power Transmission. As it is in Radiative mode, most of the Power was wasted and has less efficiency.
- In 2005, Dave Gerding coined the term WiTricity which is being used today.



- Forgotten invention was reborn in 2007 by the MIT researchers.

Basics of WiTricity.

Electricity: The flow of electrons (current) through a conductor (like a wire), or charges through the atmosphere (like lightning).

Magnetism: A fundamental force of nature, which causes certain types of materials to attract or repel each other.

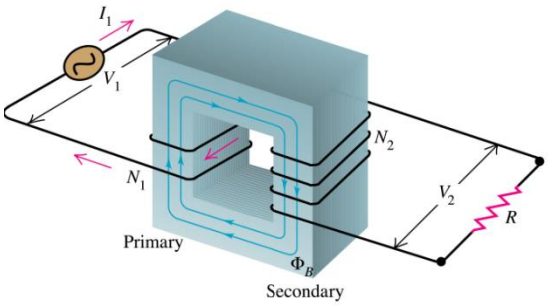
Electromagnetic Inductions: Is the production of voltage (induced current) across a conductor moving through a

magnetic field. For example, it turns out that an oscillating magnetic field produces an electric field and an oscillating electric field produces a magnetic field.

Electromagnetism Energy: A term for the interdependence of time-varying electric and magnetic fields.

Power Coupling: It occurs when an energy source has a means of transferring energy to another object.

Resonance: Is the tendency of a system to oscillate with larger amplitude at some frequencies than at others. These are known as the system's resonance frequencies.

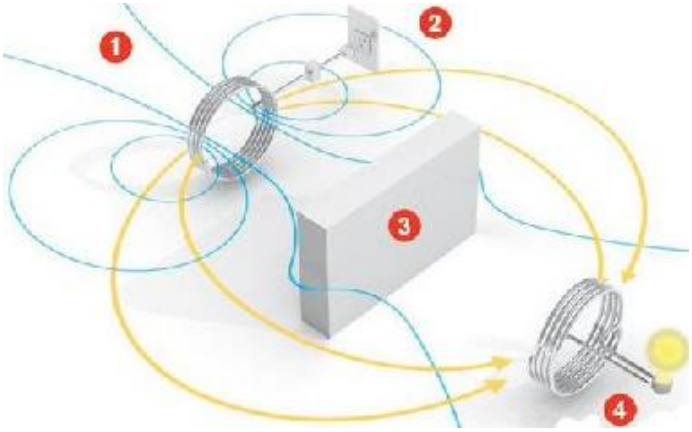


Resonant Magnetic Coupling: Magnetic coupling occurs when two objects exchange energy through their varying or oscillating magnetic fields. Resonant coupling occurs when the natural frequencies of the two objects are approximately the same.

WiTricity Technology.

- There is WiTricity power sources (transmitter) and capture devices (receiver).
- Power source provides power to the devices where as capture device received it to work.
- Power source and capture devices are specially designed magnetic resonators.
- Magnetic resonators efficiently transfer power over large distance via the magnetic near-field.

Diagram Of Power Source And Capture Device.



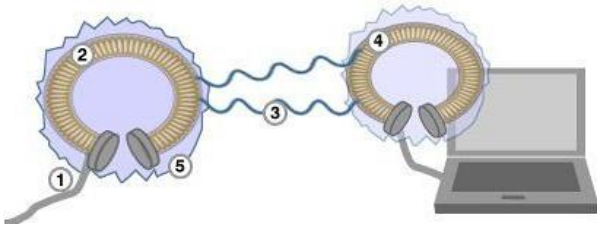
Invention Of WiTricity.

Coupled resonators.

- Two resonant objects of the same resonant frequency tend to exchange energy.
- It exchange energy strongly,while interacting weakly with living beings and other environmental objects.
- Coupled resonators are said to be operate in strongly coupled regime to avoid material absorption and radiative loss.

Strong coupling.

- The rate of energy transfer is significantly higher than rate of energy lose.
- Energy transfer is very efficient.
- Strength of interaction is very high.



How WiTricity Could Work?

1. Power from mains to antenna, which is made of coppe.
2. Antenna resonates at a frequency of 10MHz, emitting electromagnetic waves.
3. 'Tails' of energy from antenna 'tunnel' up to 2.5m (8.2ft).
4. Electricity picked up by laptop's antenna, which must also be resonating at 10MHz. Energy used to re-charge device.
5. Energy not transferred to laptop re-absorbed by source antenna. People/other objects not affected as not resonating at 10MHz.

WiTricity Technology Can Provide.

1. Direct wireless power : when all the power a device needs is provided wirelessly, and no batteries are required. This mode is for a device that is always used within range of its WiTricity power source.
2. Automatic wireless charging : when a device with rechargeable batteries charges itself while still in use or at rest, without requiring a power cord or battery replacement. This mode is for a mobile device that may be used both in and out of range of its WiTricity power source.

WiTricity Applications.

1) Consumer Electronics: automatic wireless charging of mobile electronics (phones, laptops, game controllers, etc.)in home, car, office.
2) Industrial: direct wireless power and communication interconnections at points of use in harsh environment (drilling, mining, underwater, etc.).
3) Transportation: automatic wireless charging for existing electric vehicle classes: golf carts, industrial vehicles.

Conclusion.

- The transmission of power without wires is not a theory or a mere possibility, it is now a reality. The electrical energy can be economically transmitted without wires to any distance.
- Wireless transmission of electricity have many merits like high transmission integrity and Low Loss (more than 90% efficient) and can be transmitted to any where in the globe and eliminate the need for an inefficient, costly, and capital intensive grid of cables, towers, and substations.
- The system would reduce the cost of electrical energy used by the consumer and get rid of the landscape of wires, cables, and transmission towers.
- It has negligible demerits like reactive power which was found insignificant and biologically compatible. It has a tremendous economi c impact to human society.

Finally.

Now you can Imagine the future in which wireless electricity makes everyday products more convenient, reliable, environmentally friendly and safe electricity I think the world will be change and you can say goodbye wires.

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Shtefan, I.Ye.

Reactive power compensation in electrical networks

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ABSTRACT.

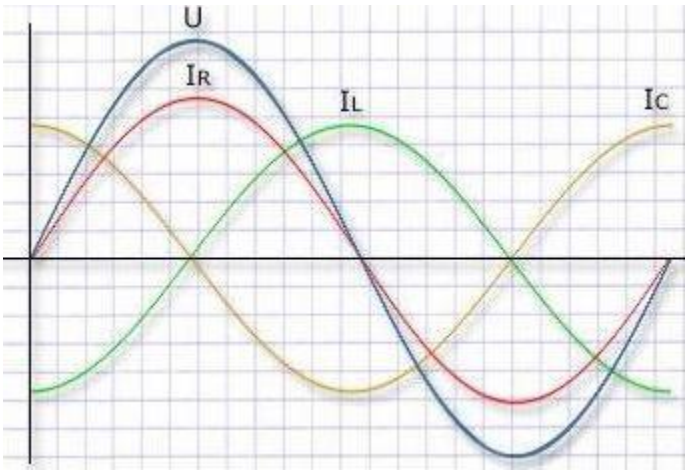
The paper outlines methods of compensating reactive power in electric lines. To reach the aim the two types of compensation devices are used including synchronous compensators and battery capacitors.

INTRODUCTION.

Reactive power is one of the main indicators characterizing the operation of the electrical system. The term "reactive power" is introduced in relation to the established modes of symmetric circuits with sinusoidal alternating current and voltage. In case of sinusoidal power transmission the positive half-wave is characterized by power transmission from the source to the consumer. Energy return occurs in the event of negative half-wave. The aggregate total power characterizing flows within power system is divided into active and reactive components.

The appearance of reactive power (RP) is associated with the presence of elements in the system that are able to accumulate and transfer electricity. These elements are: long lines of high and ultra-high voltage, coupling capacitors, cable lines, shunt capacitors having a large capacity. Other consumers have on the contrary inductive type of load, such elements include: asynchronous motors, induction heating furnaces, transformers, reactors. RP in the resulting system is equal to zero, so the costs of its production do not occur.

Application of static reactive power sources (RPS) in load nodes, helps to solve a number of problems associated with economic mode of the power system and the consumer. Also the use of the RPS has a positive effect on the quality and efficiency of power supply design objects.



Generation of active component is associated with the consumption of power load and performing useful work. Generation of active power needs a certain amount of primary energy in power plants. The second component is related to the exchange of energy between the system and the source.

The main criterion of active power balance in the system is the frequency. When under load consumption and power generation power line frequency is maintained constant at the level of 50 Hz.

At loss of synchronism of the system, the remaining generators in the power take the power from generators that are not able to cope with, the frequency of their rotation falls and as a result the system frequency also falls. Indicator of production consumption balance in the RP system is voltage.

Moreover, the figure for the RP is not a system, as a balance must be maintained in each node where the voltage level is controlled. Despite the overall compliance between production and consumption of the reactive power, the balance in the individual nodes can not be. Therefore it is very important to observe the availability of RP where there intake.

Synchronous compensator

Synchronous compensator (SC) is a synchronous motor running in an idle mode. Effectiveness of compensation reactive sources depends not only on the power equipment, but also on the regulatory systems that control these sources. So, for the SC regulatory effect increases significantly when using automatic voltage regulation (AVR). Such systems provide excitation control not only when supervised parameter deviations, but when you reject modes of the compensator and power system as a whole.

However, the possibilities of AVR are limited by inertia windings of synchronous machines. This problem can be solved by rapidly changing magnetic flux due to the saturation of individual sections of the artificial magnetic circuit with its special magnetizing windings.

Synchronous compensator (SC) in underexcitation mode consumes from the system current with inductive component, the inductive component, the more, the more underexcitation . With overdrive SC consumes network of capacitive current, loading line with reactive power and thereby reducing the voltage at the node. At a current equal to the excitation current idling compensator network of active current is consumed due to losses in the windings of the equipment.

Capacitor batteries

Along with the SC, capacitor batteries have become widespread for the purpose of RP compensation. They got a lot of popularity for cheapness and ease of operation . Introduction of new technologies and materials for manufacturing these sources RP has allowed to reduce the specific volumes, increase the service life, reduce power losses in capacitors, leading to cheaper equipment. BC to an applied sinusoidal AC give the network outpacing capacitive current thereby relieving power lines to transport RM. Voltage in this node increases.

Voltage regulation using the capacitor takes place stepwise, when connecting or disconnecting of additional capacitors. Gradual control is one of the most significant shortcomings of the SRP.

CONCLUSION.

In comparison with the voltage regulation capacitors a compensator has considerable advantage. Since regulation is smooth and combined with the latest systems of AVR compensators regulation occurs continuously, constantly maintaining high static stability. When designing electricity supply system the choice of a means of compensation have to be evaluated. Investments to install SC and BC vary considerably, however, and their effectiveness varies.

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Water as reactor coolant

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The coolant is a liquid or gaseous substance which is used for the removal of heat from the core. This heat is released in the process of nuclear fission.

The heat must be captured and transferred for use in electricity generation. To do this, reactors use coolants that remove heat from the core where the fuel is processed and carry it to electrical generators.

The coolant of the reactor determines its design, safety performance and economy of nuclear power plant (NPP).

General parameters for a good coolant.

Reliable long-term operation of a nuclear reactor can be implemented, if heat is intensively produced from nuclear fuel and moderator.

For efficient coolant work, it must fulfill a number of key specifications. Most basically, it must have efficient heat transfer properties. The coolant must also be a fluid that can fill the interstices of the core and be pumped to a steam generator or turbine.

Relevant considerations for reactors are:

- A large specific heat.
- High efficiency.
- Cost-effectiveness.
- High reliability.
- Low operating pressure at high temperatures [4].

The choice of the coolant is determined by the requirements of reactor installations and depends on conditions of their use.

I'd like to note that the coolant affects significant aspects of the reactor itself, such as the operating temperature and pressure, the size of the core, and methods of fuel handling.

Currently, water is widely used in different fields of industry as a coolant, due to the wide distribution of water in nature and its special thermodynamic properties, which associate with the structure of molecules.

The two major types of water-cooled reactors are light water reactors (PWR) and boiling water reactors (BWR).

In a boiling-water reactor (BWR), the water boils directly in the reactor core to make steam that is piped to the turbine.

In a pressurized-water reactor (PWR), the coolant water is kept under increased pressure to prevent boiling. It transfers heat to a separate stream of feed water in a steam generator, converting that water to steam.

For both boiling-water and pressurized-water reactors, the water serves as the moderator as well as the coolant. Both light water and heavy water are excellent neutron moderators. Reactors using heavy water operate on natural uranium fuel. The high pressure necessary for water-cooled power reactors determines much of the plant design [1], [6].

To meet the varied requirements to the quality of the water consumed in generation of electric and thermal energy, there is a need special physical – chemical treatment of natural water. This water is essentially the raw material, which after treatment (purification) is used for the following purposes:

1. As source materials for the production of steam in boilers, steam generators, nuclear reactors, boiling – type evaporators, steam converters;
2. To condense exhaust steam in steam turbines;
3. For cooling of various machines and units TPP and NPP;
4. As the coolant in the heating systems and hot water systems.

The most important properties of water are:

- Heat capacity: specific heat is the amount of heat that must be passed 1 kg of a substance (e.g., water) to warm it up by 1 degree. Conversely, a substance gives the same amount of energy when cooled.

- The volume change during heating and cooling: all natural materials expand when heated and contract when cooled. The only exception to this rule is water.
- Characteristics boiling when changing external pressure: if water is heated in an open tank, it boils at a temperature of 100 degrees C. If you measure the temperature of boiling water, it will appear that it is equal to 100 C. Therefore, the constant consumption of heat is used to evaporate water, i.e. changes in its physical state.
- Cavitation: cavitation is the formation of gas bubbles in the result of pressure below the pressure of vaporization of the pumped liquid to the impeller inlet [7].

The use of water as a coolant and coolant – moderator in nuclear plants has several advantages.

1. The technology of such reactors is well studied and practiced.
2. Water, having a good heat transfer properties, is simply pumped and at low-cost power.
3. The use of water as a coolant allows direct steam generation in the reactor (boiling water reactor).
4. Conventional chemically desalinated water is cheap.
5. The use of water ensures the safe operation of the reactor.
6. In reactors with water coolant-moderator it's possible to achieve a negative temperature coefficient of reactivity, which protects the reactor from a higher power.
7. The ability to create blocks of capacity up to 1600 MW [2], [5].

Disadvantages of water.

1. The presence of impurities and gases makes water chemically reactive with metals. Water has a high corrosive ratio to most metals.
2. Water freezing. This is especially true in areas where winters are cold. As a result of freezing, which leads to an increase in the amount of water turned into ice, pipes may "burst".
3. The possibility of an accident with a leak of coolant and the need of funds for its compensation.

In conclusion, I'd like to summarize that water is a common coolant and meets general parameters for a good coolant.

The use of water as a nuclear reactor coolant requires some features in design and operation of the power plant.

Water is incompressible fluid, capable of accumulating heat and when cooling it can release large amounts of heat.

Water is always available, you just need to supply it to the heating system. It is the source of life on our planet and any possible leakages do not pose a threat to health.

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Variable Speed Diesel Generator (VSDG)

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Introduction

Research into VSDGs was motivated by the desire to improve performance at part load, in terms of efficiency and running cost. VSDG have been proposed as a technological solution for the diesel generator market for over a decade. With recent cost reductions in power electronics, the VSDG has started to make more economic sense [1].

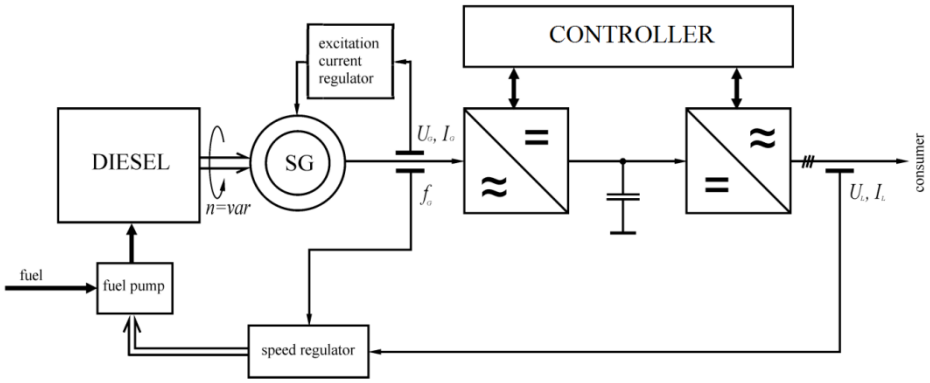


Figure 1. Schematic diagram of VSDG.

Advantages

The constant speed mode of operation is never more efficient than the variable speed and only ever matches it at near full load. Variable speed operation of a diesel engine is beneficial in terms of efficiency and therefore fuel consumption. Variable speed operation also allows more power to be produced from the same sized engine in most cases, as the speed can be increased above that of the set constant speed.

As well as being more efficient and cleaner, variable speed operation can also be quieter than constant speed, given that it runs at lower speeds when part loaded. This can be important for systems close to properties that run during the night, when the diesel engine load is likely to be low and noise pollution is more of a problem. As with the pollution control, the operating set points can also be optimised for the quietest running conditions.

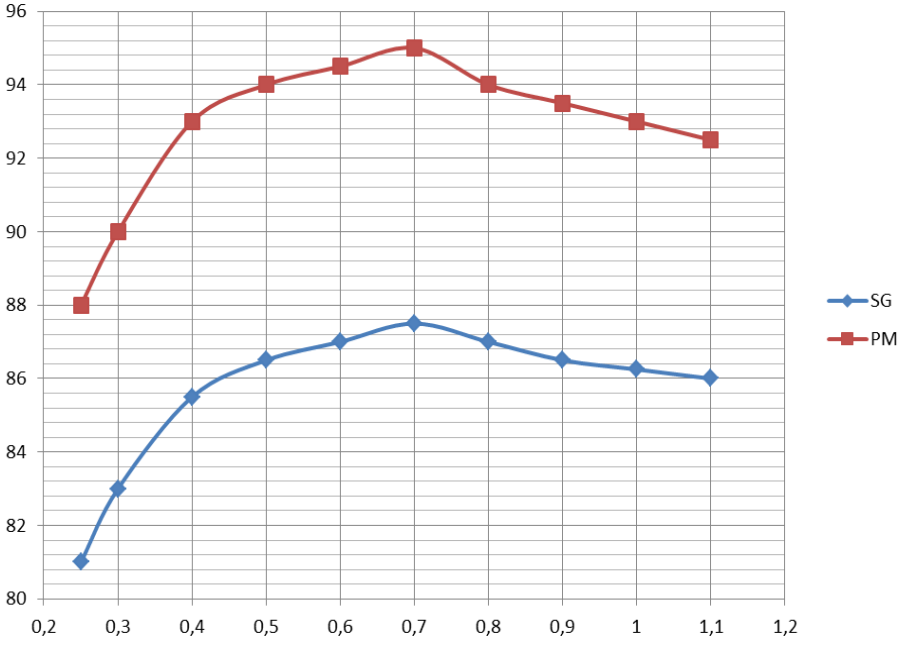


Figure 2. Generator efficiency.

A number of advantages are created by using a PMG, they can be very beneficial in standalone grids where there is no readily available supply of electricity for excitation. Most variable speed generator concepts and actual systems use PMG.

This allows them to run more efficiently, especially at lower loads when excitation power becomes a larger proportion of the power balance in a conventional generator (synchronous & asynchronous).

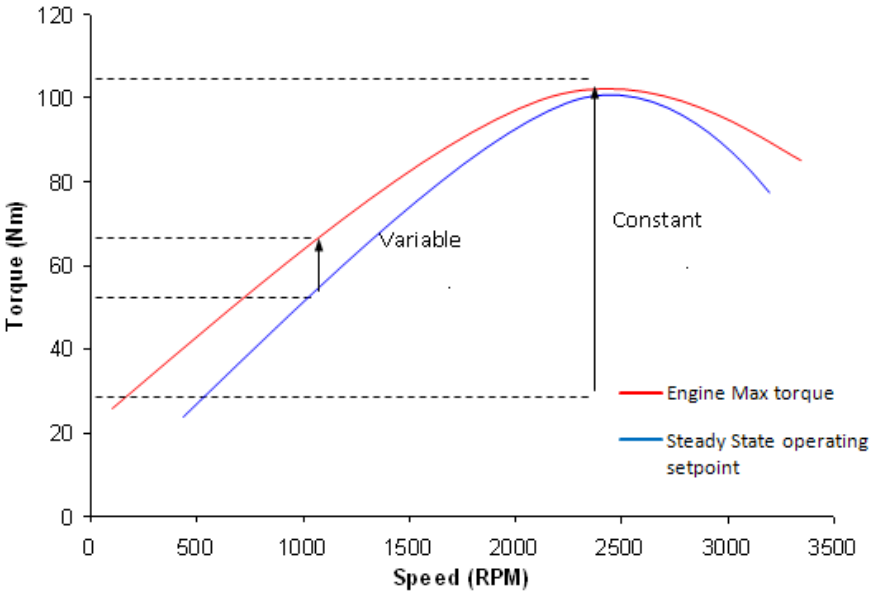
PMG have the ability to be more reliable than conventional generators, because they are selfexcited and can be mounted directly on to the engine crankshaft, which removes the slip rings and bearings fitted to standard genset that would otherwise need regular maintenance.

On Figure 2 it can be seen that the permanent magnet generator is more efficient than the synchronous generator for all load situations, At part load, the Permanent magnet generator performs much better than the synchronous generator, never dropping below 90% efficiency which is greater than the maximum achieved by the synchronous generator. Using a PMG gives the complete generator and converter system an overall efficiency of around 85-90% (0.95*0.93=0.88), which is comparable to a synchronous generator on its own.

Disadvantages

All variable speed generators need converters to control the voltage and frequency of power supplied to the grid. A good converter can run at up to 95% efficiency, but all have losses associated with switching devices and static elements such as capacitors, diodes and inductors. Permanent Magnet Generators (PMG) are more efficient than other generators, owing to their absence of electrical excitation, this allows them to reinstate some of the loss from the converter.

The additional cost of power electronics and PMG dramatically increases the cost of the diesel genset, but also increase the control requirements, complexity and therefore total cost.



The dynamic performance of the VSDG is a potential disadvantage, as it can be compared at any given instant to a constant speed diesel generator with the maximumoutput related to the set rotational speed. Therefore, the generator seems to increase in size as the rotational speed increases up to the maximum power.

Figure 3. Diesel Generator Loading.

The additional torque available at any given moment is the diesel engine maximum power (top line) minus the steady state operation set point (bottom line), demonstrated by the variable speed arrow in Figure 3 [2].

The torque available to meet step load increases for the constant speed generator (right arrow) at the same power starting point as the variable speed operation (left arrow), is much larger. The instantaneously available torque significantly affects the generators dynamic stability. If a step load above the available power is applied to the generator, it will not be able to meet the demand quickly and the diesel engine could stall causing a blackout. For a small generator sized for a community of 10-15 households, the equivalent demand of two electric

kettles (3 to 4kW) being switched on or a small drop in wind speed for a high penetration wind-diesel system could be enough to seriously compromise the VSDG stability. To compound matters any load increase may initially decrease the engine speed leaving less available power to meet the load change. If a step load increase is large enough to use all the immediately available power, the generator would then be in a very dangerous/unstable condition, as it would be unable to accelerate to the new set speed, and even a small load increase after that would be capable of crashing the system.[3].

VSDGs are a new technology and therefore the reliability of the systems has a level of uncertainty attached to it. This is a significant obstacle to up take, especially in remote communities where it would be used as the main source of power.

Although power electronics are generally seen as reliable and require very little if any maintenance, their addition can also take away the communities ability to fix faults impacting on their independence. The modularity of many power electronic components also means that even if a suitably qualified person is available to find faults and carry out repairs, spare parts would need to be readily available. As these components are often expensive, they are not likely to be stockpiled and so they would need to be ordered in. Many power electronic components are in short supply and therefore can have long lead times adding to the transport delays, which can also affect these remote areas.

Summary

To summarize, conventional diesel gensets are a reliable but expensive way to supply electricity. The main reason for their expense is the price of diesel fuel, which is further aggravated by the inefficient running of the diesel engine at part load. To overcome this problem, the running of the diesel engine at the optimum speed for the load (i.e. variable speed) has been suggested. Although this is not a new idea, the increased cost of the variable speed diesel generator, mainly because of the need for power electronics, is only just starting to be offset by the fuel savings. Variable speed operation of the diesel genset is expected to be beneficial for most offgrid community applications.

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Научн. рук.: Плотников И.А., к.т.н., доц. каф. ЭПП.

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Automatische Wiedereinschaltung

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Die Automatische Wiedereinschaltung (AWE) ist ein Begriff aus der elektrischen Energietechnik. Sie wird in der Regel an mit Hochspannung betriebenen elektrischen Freileitungen, sowie an der Sammelschiene und am Transformator eingesetzt.

Kommt es auf einer Freileitung zu einem Kurzschluss, entsteht häufig ein Störlichtbogen, der nicht von selbst verlischt. Der Strom steigt und der Relaisschutz erzeugt das Abschaltungssignal.

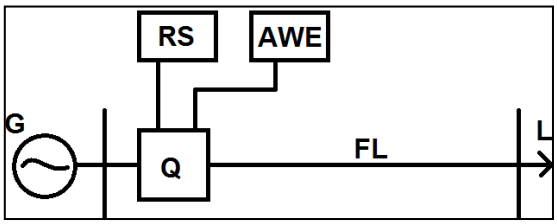

Abb. 1. Schema der Arbeitsweise eines AWE,. wo: G – Generator, Q – Leistungsschalter, RS – Relaisschutz,. AWE – automatische Wiedereinschaltung, FL – Freileitung, L – Last.

Da durch den Lichtbogen die Fehlerursache häufig beseitigt wird (z.B. ein Ast, der auf die Leitung gefallen ist, verbrennt; ein Blitzeinschlag), führt man eine automatische Wiedereinschaltung durch.

AWE schaltet den Leistungsschalter nach kurzer Zeit ("Pausenzeit") wieder automatisch zu: bei einpoligen Fehlern nach etwa 0,5 bis 3 Sekunden, bei dreipoligen Fehlern nach 0,2 bis 0,5 Sekunden.

Besteht nach dem Wiedereinschalten der Fehler nicht mehr, spricht man von einer erfolgreichen AWE (AWE mit Erfolg).

Besteht der Fehler immer noch, spricht man von einer erfolglosen AWE (AWE ohne Erfolg). In diesem Fall schaltet der Relaisschutz den Leistungsschalter aus und dieser bleibt ausgeschaltet.

Zurzeit existieren folgende Typen der AWE:

- drei- und und einpolige AWE;
- automatische Eintakt- und Zweitaktwiedereinschaltung.

Die dreipolige AWE ist einfacher in der Nutzung, als einpolige AWE.

Deshalb werden die dreipolige AWE an elektrischen Freileitungen mit Spannungsebene bis 500 kV eingesetzt. Und die einpolige AWE von 500 kV.

Breite Anwendung hat die automatische Eintaktwiedereinschaltung bekommen.

Automatische Zweitaktwiedereinschaltung wird nur auf Verlangen der Verbraucher hin eingesetzt.

Stepanchenko, O.E.

Harvesting lightning energy

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What do we know about lightning? We know that lightning – a powerful electric discharge. Also we know that lightning has enormous power voltage and current. And some people wonder: Is it possible to catch lightning and transport to energy grids? Talking about this has been going on for a long time, but it is possible that someday we will see such stations.

Describing this process, it is necessary to start with question «How is lightning formed?».

Lightning formed when water and ice move around inside the cloud; forced up by warm air currents, down by gravity, and compressed in the cloud. The particles in the cloud become charged. It's not clear how it happens, but charges separate in the cloud. Positive charges move up, and negatives move down.

Once a significant charge separation has built up, the positive and negative charges seek to get each other an neutralise. 'Streamers' come up from the ground to form a pathway. Once a pathway is completed a spark forms, neutralizing the charge.

As the negative charge races down, the air surrounding it heats up. The spark is very hot at almost 20,000 degrees Celsius, and it fast heats the air to create a shock wave.

Considering light travels very fast – about 300 million metres per second, and that sound only travels at 300 metres per second; light is a million times faster than the sound produced. To find out how far away the storm is, you can count how long you hear the sound after the lightning. For every 4 seconds between the flash and the rumble, the thunderstorm is 1 mile away.

Let us now proceed to consider data NASA.

By using data from the NASA Tropical Rainfall Measuring Mission (TRMM) satellite, a study published in the August 2006 issue of the Bulletin of the American Meteorological Society identified the regions on Earth that experience the most intense thunderstorms.

The researchers examined global thunderstorm data supplied by TRMM from 1998-2004. To determine an individual storm's intensity, they specifically examined the height of radar echoes, radiation temperature, and lightning flash rate, each measured by separate TRMM instruments.

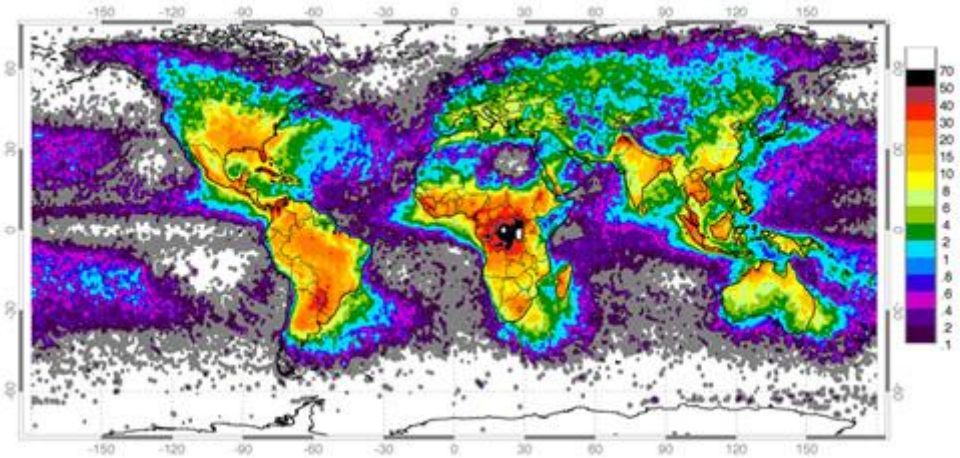

Image (left): This map reveals the uneven distribution of worldwide lightning with color variations indicating the average annual number of lightning flashes per square kilometer. Produced by NASA Marshall Space Flight Center's Lightning Imaging Sensor Science Team, the map includes data taken over an 11-year period from NASA's Optical Transient Detector and TRMM's Lightning Imaging Sensor. The yellow and red colors indicate higher concentrations of lightning. Credit: NASA/MSFC.

Let's imagine if a harnessing method were derived, the primary drawback of lightning power is its inconsistency. Storms might come regularly into some regions, but would enough lightning potential fall within the range of the device to make it worth while? See NOVA's special on Lightning (1989), to see how difficult it is to draw down lightning even in the most prone areas, using rockets attached.

"One of the things that has chilled my excitement about harnessing the tremendous power in lightning is to realize that some of the same electrostatic and possibly even cosmic forces that drive lightning might also be at work in some of the other free energy technologies such as overunity electromagnetic generators -- but in a much more constant and reliable manner." -- Sterling D. Allan, Aug. 5, 2010.

"Each year lightning destroys more property and causes more injuries than hurricanes, floods and tornadoes combined? It can cause structural damage to buildings, destroy electronics and damage electrical and communication systems....the cost of this damage can be astounding!".

Voltage: A typical lightning bolt bridges a potential difference (voltage) of several hundred million volts.

A typical lightning bolt may transfer 1020 electrons in a fraction of a second, developing a peak current of up to 1000 kiloamperes.

Current: Most measurements have been in the range 5,000 to 20,000 amps. Currents over 200,000 amps have been reported.

Assuming that you are lucky and get a lightning bolt to hit your conductor, there would be major difficulties in storing the energy and then converting it to alternating current so it can run your appliances. In addition, any solution to these problems would need to be able to withstand the enormous surges in energy generated by each strike.

Finally, much of the lightning bolt's energy goes into heating the surrounding air to temperatures greater than the surface of the Sun. So even if you managed to overcome the problems of collecting, storing and converting the energy from the lightning to make it useful, you would still only be harnessing a small proportion of the lightning bolt's power.

Moving on to our next point – The experimental setup.

ROANOKE, VA -- October 11, 2006 -- Alternate Energy Holdings (PINKSHEETS: AEHI), announced the successful development of a model prototype to demonstrate the 'capturing' capabilities of AEHI's marketable lightning farm technology.

By collecting power from the ground area surrounding a lightning strike and converting it into usable electricity to be sold through existing power grids, AEHI is able to harness the natural energy delivered in a bolt of lightning. Lightning harvesting is a clean energy solution that will not only eliminate numerous environmental hazards associated with the energy industry it will also significantly reduce the costliness of power production. When amortized over 4-7 years, a lightning farm will be able to produce and sell electricity for as low as $0.005 per kilowatt hour, thus significantly undercutting the current production costs of its competing energy sources.

In the summer of 2007, an alternative energy company called Alternate Energy Holdings, Inc. (AEHI) tested a method for capturing the energy in lightning bolts. The design for the system had been purchased from an Illinois inventor named Steve LeRoy, who had reportedly been able to power a 60-watt light bulb for 20 minutes using the energy captured from a small flash of artificial lightning. The method involved a tower, a means of shunting off a large portion of the incoming energy, and a capacitor to store the rest. According to Donald Gillispie, CEO of AEHI, they "couldn't make it work," although "given enough time and money, you could probably scale this thing up... it's not black magic; it's truly math and science, and it could happen."[6].

A relatively easy method is the direct harvesting of atmospheric charge before it turns into lightning. At a small scale, it was done a few times with the most known example being Benjamin Franklin's experiment with his kite. However, to collect reasonable amounts of energy very large constructions are required, and it is relatively hard to utilize the resulting extremely high voltage with reasonable efficiency.

According to Martin A. Uman, co-director of the Lightning Research Laboratory at the University of Florida and a leading authority on lightning, a single lightning strike, while fast and bright, contains very little energy, and dozens of lightning towers like those used in the system tested by AEHI would be needed to operate five 100-watt light bulbs for the course of a year. When interviewed by *The New York Times*, he stated that the energy in a thunderstorm is comparable to that of an atomic bomb, but trying to harvest the energy of lightning from the ground is "hopeless".

In consequence, it can be concluded that the probability of obtaining energy from lightning is extremely small. But technology does not stand still, and perhaps in the future, such stations still appear.

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The influence of geomagnetic storms on transformers

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The aim of the article is to describe the influence of geomagnetic storms on transformers and connection with the magnetic field of the earth.

A geomagnetic storm is a temporary disturbance of the Earth's magnetosphere caused by a solar wind shock wave and cloud of magnetic field which interacts with the Earth's magnetic field.

Geomagnetic storm could be one of the biggest natural disasters. It will disrupt telephone communications, television, radio, and Internet.

On September 1-2, 1859, there was the largest recorded geomagnetic storm. From August 28 until September 2, 1859, numerous sunspots and solar flares were observed on the Sun, the largest flare occurred on September, 1. It is called a Solar storm of 1859 or the Carrington Event.

It can be assumed that a massive coronal mass ejection, associated with the flare, was launched from the Sun and reached the Earth within eighteen hours – a trip that normally takes three to four days. A prominence is a large, bright, gaseous feature extending outward from the Sun's surface, often in a loop shape. This is coronal mass ejection. Coronal mass ejections release huge quantity of matter and electromagnetic radiation into space above the sun's surface, either near the corona, or farther into the planet system, or beyond. More severe proton events can be associated with geomagnetic storms that can cause widespread disruption to electrical grids. Power grids are only sensitive to changes in the Earth's magnetic field.

The increase in the solar wind pressure initially compresses the magnetosphere and the solar wind's magnetic field interacts with the Earth’s magnetic field and transfers an increased energy into the magnetosphere. Both interactions cause an increase in movement of plasma through the magnetosphere and an increase in electric current in the magnetosphere and ionosphere. Electric field weakens and starts to fall charged particles. Bulk charging occurs when energetic particles, primarily electrons, penetrate power grids and deposit their charge. Transformers connected to long, overhead power transmission lines, induced currents in the solar storm cause saturation of the core, and it begins to melt due to magnetic perturbations.

Modern power grids are working to maximum efficiency, which means that the system is not amortized, there are no additional transformers that do not have additional lines. Transformers will be destroyed and we cannot do anything but to create new ones. Today, large areas of the planet plunged into darkness for 10 years or more.

The solution of this problem is to build power grids to have more transformers. There is still an expensive option, transformers immersed in water.

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Nuclear Contamination

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Nuclear contamination (or sometimes it's called nuclear pollution) is a presence of radioactive substances on environment. It's the presence of radioactive substances on surfaces or within solids, liquids or gases (including the human body), where their presence is unintended [2]. Of course it's very harmful for our organism and for all living creatures that inhabit our planet. The environmental impact of nuclear power results from the nuclear fuel cycle, operation, and the effects of nuclear accidents.

The routine health risks and greenhouse gas emissions from nuclear fission power are small relative to those associated with coal, oil and gas. However, there is a "catastrophic risk" potential if containment fails which in nuclear reactors can be brought about by overheated fuels melting and releasing large quantities of fission products into the environment. The public is sensitive to these risks and there has been considerable public opposition to nuclear power [4].

Nuclear Contamination is pollution caused by nuclear waste which is generated from the unusable radioactive products from different fields. Unfortunately, humans are polluting the Earth… and radiation, which is dangerous, though there in nature.

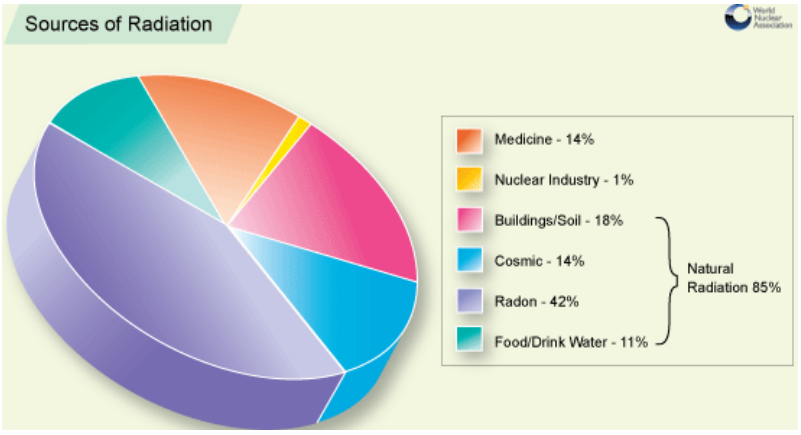

Fig.1 (left). "Sources of Radiation" diagram [6].

If radioactive material is not in a sealed source container, it might be spread onto other objects. Contamination occurs when material that contains radioactive atoms is deposited on materials, skin, clothing, or any place where it is not desired. It is important to remember that radiation does not spread or get "on" or "in" people; rather, it is radioactive contamination that can be spread. A person contaminated with radioactive material will receive radiation exposure until the source of radiation (the radioactive material) is removed [3].

Water is needed to cool the reactors in nuclear power plants. Cold water from lakes and rivers is used for this process. As a result of this a lot of hot water is generated. It's called thermal pollution since organisms die when temperatures rise [1].
Low-level radioactive waste is waste, which is spent nuclear fuel or highly radioactive waste produced if spent fuel is reprocessed. High levels of radioactive contamination – unlike low levels – may pose major risks to people and the environment. People can be exposed to potentially lethal radiation levels [5].

Figure 1 shows a diagram "Sources of Radiation". As can be seen, nuclear industry which is yellow – only 1% of the global pollution. The most – is radon (42%). But others sources wasn't considered in this paper.

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Employing electric resonance for reducing transmission losses

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Abstract

The subject of the paper is power transmission losses caused by reactance losses. Possible solution to the problem with resonance-based equipment is considered and necessary calculations are presented.

Key words: resonance, transmission losses, power line, reactive impedance, compensation, frequency, reactive impedance, capacitor bank, overvoltage, shunt reactor, power line phases.

Introduction

Reducing power transmission losses is one of the most important issues of modern power engineering. There are different reasons for transmission losses, one of which is reactance losses, causing hazardous overvoltage. To solve this problem various devices have been developed and resonance-based equipment is considered to be one of the most efficient and promising.

Theoretical foundation.

Resonance is a sharp increase in the amplitude of forced oscillations when impressed frequency is close or equal to the natural frequency of the oscillatory system. Resonance can be of two types: mechanical resonance and electric resonance.

Mechanical and electrical resonance have some common features: in both cases resonance occurs when impressed frequency coincides with fundamental frequency of the system. Impressed frequency is equal to the source frequency, while natural frequency of any electric system depends on the relation between inductance and circuit capacitance. Electric resonance is divided into acceptor resonance and parallel resonance. In case of acceptor res-

onance inductance and capacitance are connected in series, in case of parallel resonance they are connected in parallel.

Devices employing the properties of electric resonance are widely applied in power engineering to reduce transmission losses and prevent overvoltage hazardous for electrical insulation equipment at substations.

For better understanding of the device construction and operating principles the equivalent circuit and real variables of a three-phase overhead transmission line are to be examined. Any power transmission line can be presented as a line of infinite active and reactive impedances and conductivities evenly aligned. In the given paper a simplified method for calculating series compensation is considered. The power line is presented as an equivalent-Pi with series coil resistance *(R)* and inductance *(X)*. Capacitive susceptance *(B)* is divided and inserted at the sending and receiving ends of line (fig.1):

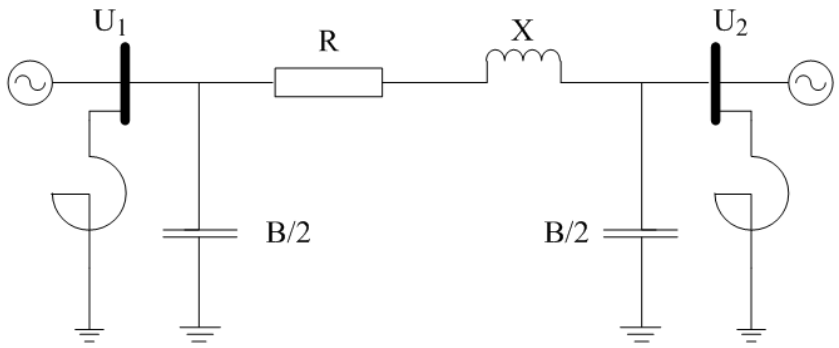

Fig.1.

Calculations

For further calculations we will consider a 500 kV overhead transmission line with a definite set of parameters:

power line voltage-margin *U= 575-500 kV.*

capacitive conductivity per square kilometer $b_o = 3{,}62 \cdot 10^{-6}$ *S.*

specific charge capacitance $q_o = 0{,}905$ *Mvar.*

inductance $X_L = 0{,}35$ *ω/km.*

coil resistance $R_o = 0{,}02$ *ω/km.*

line length *l = 500 km.*

It must be noted that power line coil resistance is more than 10 times less than inductance. Therefore major transmission losses account for reactive impedance $X = X_o l$. Reactive impedance can be compensated if a bank of capacitors will be inserted in the split of the power line. The required capacitor bank will be calculated with the acceptor resonance formula at the industrial circular frequency: $\omega L = 1/\omega C$ or $X_o\, l = 1/\omega C$. Thus, $C = 1/(\omega X_o\, l) = 1/(314 \cdot 0{,}35 \cdot 500) = 18{,}2$ μF.

The capacitor bank inserted into the split of the power line is called a series compensator (dotted line in fig.1).

Every power line has a certain charge capacity of $Q = q_o\, l$. Therefore, a power line is a reactive power source. It can result in end-overvoltage (substation bus bars) hazardous in some modes to electric insulation.

To prevent overvoltage shunt reactors are successfully used in power engineering. Shunt reactors are heavy-gauge bus duct coils embedded in concrete. Due to their simple and robust construction dry shunt reactors are the most cost-effective means to provide for the power line capacity compensation.

Shunt reactors are inserted between power line phases and ground and provide power line compensation (fig.1). Evidently, in this case parallel resonance (current resonance) occurs.

We shall determine capacitive susceptance of the power line being examined:

$$B = b_0 L, B = 3{,}62 \cdot 10^{-6} \cdot 500 = 1{,}810 \cdot 10^{-3} \text{ S.}$$

Knowing the power line capacitive susceptance, we shall find out charge capacity of the power line at rated voltage:.

$$Q_l = U^2 B, Q_l = 500000^2 \cdot 1{,}81 \cdot 10^{-3} = 4{,}525 \cdot 10^8 \text{ Var.}$$

In case of open transmission line (zero transmission capacity), power line charge capacity is equal to reactor charge capacity, i.e. $Q_l = Q_r$.

Now we shall deduce resistance from the reactor charge capacity formula: $Q_r = U^2 \frac{1}{x_r}$, from here. $x_r = \frac{U^2}{Q_r}$, $x_r = \frac{25 \cdot 10^{10}}{4{,}525 \cdot 10^8} = 552$ *ω.*

Now we shall determine cumulative inductance of two reactors, necessary for full compensation of the power line charge capacity:

$$L_r = \frac{x_r}{\omega} = \frac{x_r}{2\pi f} = \frac{552}{2 \cdot 3.14 \cdot 50} = 1{,}76 \text{ H.}$$

Conclusion

Therefore, installation of a capacitor bank and two shunt reactors with the calculated values will ensure full reactance compensation and power line conductivity, considerably reduce transmission losses, and prevent hazardous overvoltage.

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AC/DC Transmission

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Abstract

Disputes between supporters of AC and DC take place since the time of Tesla and Edison. Which is better? In this paper we try to understand this poll. First, we consider the advantages and disadvantages of AC and DC. Next, consider the option of combined AC and DC. In conclusion, we can conclude which of the two options would be preferable.

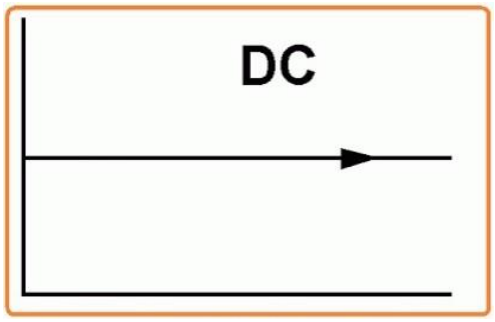
Introduction.

Consumption of electricity is an essential life process of modern society. Electricity is used everywhere, starting with the largest industrial facilities, ending appliances in our homes. Energy consumption is growing every year, increases the amount of power transmitted over power lines. This greatly affects the stability of the power system. Increasingly, there are questions about transmission of electric power. Nikola Tesla and Thomas Edison divided technical society into two parts, which are still in their irreconcilable views: direct current or alternating current. Which is better?.

Comparison between AC and DC transmission system (with their advantages and disadvantages)

Electric Power can be transmitted in both AC and DC. But there are some advantages and disadvantages of both systems. So it is important that we discuss technical advantages and disadvantages of both AC and DC Systems.

DC Transmission:

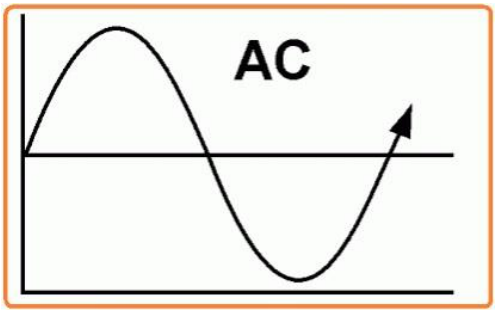


Advantages:

1. There are two conductors used in DC transmission while three conductors required in AC transmission.
2. There are no Inductance and Surges (High Voltage waves for very short time) in DC transmission.
3. Due to absence of inductance, there are very low voltage drops in DC transmission lines compared with AC (if both Load and sending end voltage is same).
4. There is no concept of Skin effect in DC transmission. Therefore, small cross sectional area conductor required.
5. A DC System has a less potential stress over AC system for same Voltage level. Therefore, a DC line requires less insulation.
6. In DC System, there is no interference with communication system.
7. In DC Line, Corona losses are very low.
8. In High Voltage DC Transmission lines, there are no Dielectric losses.
9. In DC Transmission system, there are no difficulties in synchronizing and stability problems.
10. DC system is more efficient than AC, therefore, the rate of price of Towers, Poles, Insulators, and conductor are low so the system is economical.
11. In DC System, the speed control range is greater than AC System.
12. There is low insulation required in DC system (about 70%).
13. The price of DC cables is low (Due to Low insulation).
14. In DC Supply System, the Sheath losses in underground cables are low.
15. DC system is suitable for High Power Transmission based on High Current transmission.
16. In DC System, the Value of charging current is quite low, therefore, the length of DC Transmission lines is greater than AC lines.

Disadvantages:

1. Due to commutation problem, electric power can't be produced at high (DC) voltage.
2. For high voltage transmission, we can't step the level of DC voltage (as transformer can't work on DC).
3. There is a limit of DC switches and circuit breakers (and costly too).
4. Motor generator set is used for stepping down the level of DC voltage and the efficiency of motor-generator set is lower than transformer so the system makes complex and costly.
5. The level of DC Voltage can't be changed easily. So we can't get the required voltage for electrical and electronics appliances (such as 5 Volts, 9 Volts 15 Volts, 20 and 22 Volts etc) directly from transmission system.



AC Transmission:

Nowadays, the generation, transmission and distribution are mostly in AC.

Advantages:

1. AC circuit breakers is cheaper than DC circuit breakers.
2. The repairing and maintenance of AC substation is easy and inexpensive than DC substation.
3. The level of AC voltage may be increased or decreased by step up and step down transformers.

Disadvantages:

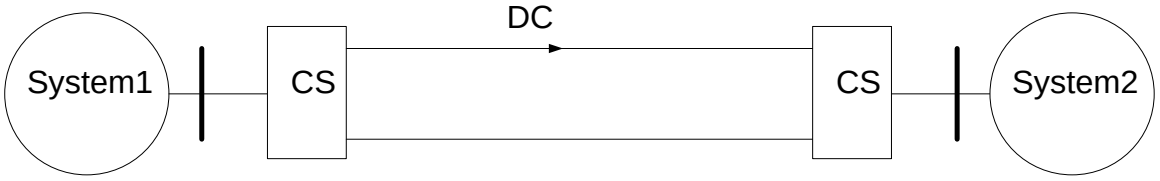
1. In AC line, the size of conductor is greater than DC line.
2. The cost of AC transmission lines is greater than DC transmission lines.
3. Due to skin effect, there are more losses in AC system.
4. In AC lines, there is capacitance, so continuously power loss when there is no load on lines or the line is open.
5. Other line losses are due to inductance.
6. More insulation is required in AC system.
7. Also corona losses occur in AC System.
8. There is telecommunication interference in AC system.
9. There are stability and synchronizing problems in AC system.
10. DC system is more efficient than AC system.
11. There are also re-active power controlling problems in AC system.

The combination of AC and DC electric power transmission

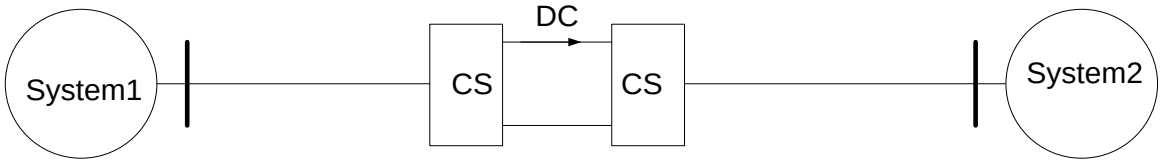
To date, no satisfactory design created switches high voltage DC. Disconnecting the DC line closes the gates of the RS (rectifying substation). Therefore DC transmission has bloc diagram: RS – DCL – IS without the addition of another IS at intermediate points of the line. The technical difficulty of the branched transmission lines caused by DC also features the regime of regulation, to ensure sustainability, the need to contain the accident.

In turn, we can't use the AC line to connect two or more power systems operating in different phases, as this could cause huge equalization currents asynchronous mode. Especially, we can't join systems with varying frequency.

In such situations, the application will be in simultaneous use of AC and DC.



Pic.1. DC transmission.



Pic.2. Inset DC.

In DC power is only used to transport electricity from remote power plants in the receiving system, or from one system to another. For this purpose, an AC electric power generated by the generators of the transmission system must first be converted into DC power, then transmitted by a line, then converted, but in the AC power and transmitted to the receiving system.

When using a direct current inset, at a distance of transportation of energy is carried out using alternating current. Moreover, typically this distance is relatively small, since the liner is used to communicate to each other adjacent systems. Direct current only plays the role of managers, which fully unleashes the connected systems in frequency and, from this point of view, making them independent of each other.

Conclusion

Having two substations (rectifier and inverter) – expensive and complex to operate – hinders widespread use of DC lines. Application of DC electrical energy for transmission can

be an alternative for long-distance AC lines (1500 km and above and the transmission power of 2,000 MW). To a lesser extent DC power is used in solving technical problems of formation of interconnected power systems which cannot be solved by using AC power (ensuring stability of parallel operation, not synchronous communications of power systems, long distance cable lines), as well as in cases where the construction of aircraft and cable lines for AC transmission line is not economically feasible, for example, crossing the sea space. In other cases it is justified to use alternating current electric power for transmission. It is worth noting quite successful practices relating to combined work of both methods.

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Hydro Power Plants

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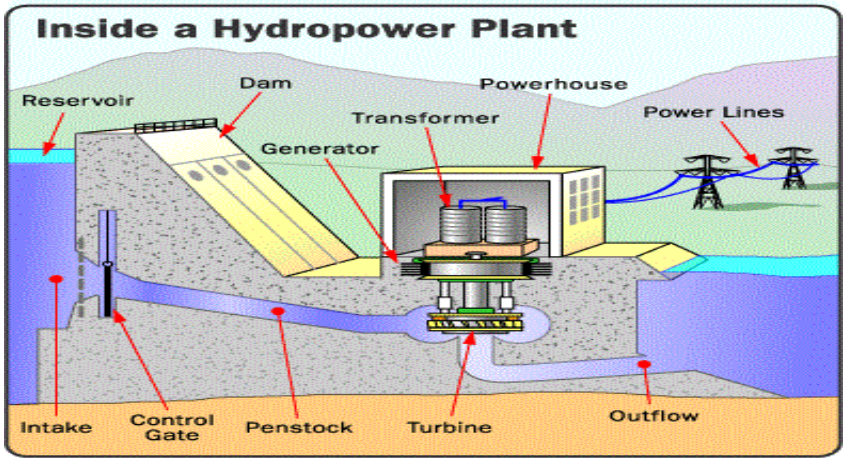
Hydroelectricity is the term referring to electricity generated by hydropower; the production of electrical power through the use of the gravitational force of falling or flowing water. It is the most widely used form of renewable energy, accounting for 16 percent of global electricity generation – 3,427 terawatt-hours of electricity production.

The main aspects of hydro power plants:

1) Design and Operation.
2) Generating methods.
3) Advantages and Disadvantages.

Design and Operation

Operation of HPP 's not much harder than where he worked first station . Thanks circuit hydraulic structures provided the necessary water pressure forces acting on that turbine blades drive a generator . Just today, for HPP does not need to use the Niagara Falls. Hydroelectric their hands can also produce the right amount of energy. Achieve the necessary force head through the construction of a series of dams. Note that in using various types of hydroelectric turbines. The main factor that affects the choice – the power head .All power equipment is located in the power house . In addition to the engine room, which houses all hydraulic units are departments that contain extra equipment, transformer station, device control and management of hydropower etc.



Generating methods

Conventional (dams) – Most hydroelectric power comes from the potential energy of dammed water driving a water turbine and generator. The power extracted from the water depends on the vol-

ume and on the difference in height between the source and the water's outflow. This height difference is called the head. The amount of potential energy in water is proportional to the head. A large pipe (the "penstock") delivers water to the turbine.

Pumped-storage – This method produces electricity to supply high peak demands by moving water between reservoirs at different elevations. At times of low electrical demand, excess generation capacity is used to pump water into the higher reservoir. When there is higher demand, water is released back into the lower reservoir through a turbine. Pumped-storage schemes currently provide the most commercially important means of large-scale grid energy storage and improve the daily capacity factor of the generation system. Pumped storage is not an energy source, and appears as a negative number in listings.

Run-of-the-river – Run-of-the-river hydroelectric stations are those with small or no reservoir capacity, so that the water coming from upstream must be used for generation at that moment, or must be allowed to bypass the dam.

Tide – A tidal power plant makes use of the daily rise and fall of ocean water due to tides; such sources are highly predictable, and if conditions permit construction of reservoirs, can also be dispatchable to generate power during high demand periods. Less common types of hydro schemes use water's kinetic energy or undammed sources such as undershot waterwheels. Tidal power is viable in a relatively small number of locations around the world.

Underground – An underground power station makes use of a large natural height difference between two waterways, such as a waterfall or mountain lake. An underground tunnel is constructed to take water from the high reservoir to the generating hall built in an underground cavern near the lowest point of the water tunnel and a horizontal tailrace taking water away to the lower outlet waterway.

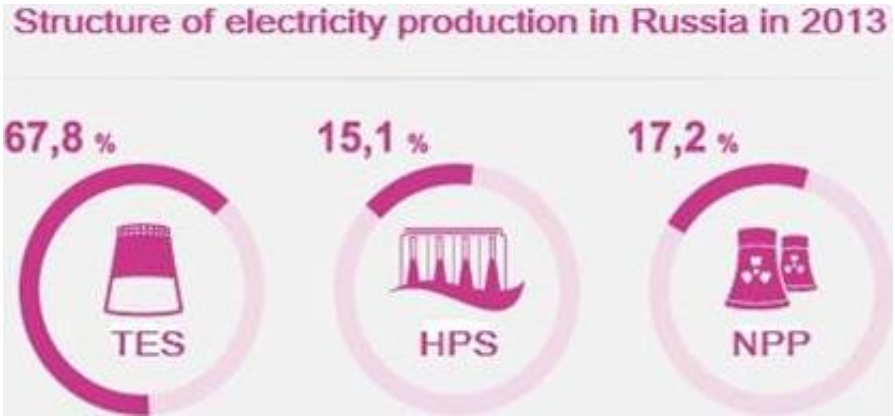
Advantages and Disadvantages of HPP's

Advantages :

- use of renewable energy;
- very cheap electricity;
- work is not accompanied by harmful emissions into the atmosphere;
- fast (relatively CHP / CHP) output to output mode after the operating power station.

Disadvantages:

- flooding of arable land;
- construction is carried out only where there are large reserves of water power;
- mountain rivers are dangerous because of high seismic areas;
- environmental problems : reduced and nonregulated water releases from reservoirs for 10-15 days (until their absence), lead to a restructuring of the unique floodplain ecosystems across the river stream, as a result, pollution of rivers, reducing the trophic chain, reducing the number of fish, aquatic invertebrates elimina-



tion animals, increased aggressiveness components midges (gnats) due to malnutrition larval stages, the disappearance of many species of nesting migratory birds, inadequate hydration floodplain soils, vegetation succession negative (depletion phytomass), reducing the flow of nutrients in the oceans.

Hydropower in Russia.

Hydropower is a good alternative for Russia, unnecessarily in our country there are many large and powerful rivers, as well as a large share of electricity generation refers to the TES, which is harmful to the country's ecology.

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Renewable sources of energy – the solution to climate change

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Climate change is arguably one of the greatest environmental threats the world is facing. The impacts of disruptive change leading to catastrophic events such as storms, droughts, sea level rise and floods are already being felt across the world.

While the Kyoto Protocol, which aims to reduce greenhouse gas emissions, is slowly impacting on energy markets, scientists are increasingly advising policymakers that carbon emission reductions of beyond 60% are needed over the next 40-50 years [1]. How will we achieve such a dramatic reduction in carbon emissions?.

At the heart of the issue is an energy system based on fossil fuels that is mainly responsible for greenhouse gas emissions. On the contrary, renewable energy provides one of the leading solutions to the climate change issue. By providing ‘carbon-neutral’ sources of power, heat, cooling and transport fuels, renewable energy options such as wind, solar, biomass, hydro, wave and tidal offer a safe transition to a low carbon economy.

This outlines the role that renewable energy can play in reducing greenhouse gas emissions such as carbon and methane. It highlights the success to date and the activity already happening across Europe and the rest of the world. It assesses its potential, and identifies how renewable energy is central to climate change policy and delivering large carbon dioxide reductions.

According to the vast majority of climate scientists, climate change is already underway. The past decade has seen the warmest 6 years since records began. A third of global habitats are at risk, and extreme events such as floods, storms and drought are becoming more frequent. The financial consequences of climate change are also becoming apparent – with insurance claims due to weather-related damage increasing dramatically over the past few decades.

The following effects of an increase in global average temperature have been identified:

- Steady rise of the sea level.
- Flooding of coastal areas.
- Frequent extreme weather conditions.
- Frequent poor harvest.
- Water shortage.
- Devastations.
- Loss of biodiversity.
- Increase of infections.

The climate change problem is essentially a fossil fuel energy problem. While agriculture, land-use changes, cement production and the use of chemicals all contribute to green-

house gas emissions, more than 70% of the problem is due to the unsustainable use of fossil fuels. The climate change challenge means shifting away from fossil fuels in the home, industry, at work and the way we travel. Furthermore, global energy demand is predicted to rise as countries industrialize and population continues to grow.

Renewable energy offers safe, reliable and increasingly cost-effective alternatives for all our energy needs – predominantly heating, cooling, electricity and motive power for transport. It can provide everything that fossil fuels currently offer in terms of energy services and by that dramatically reduce climate change gas emissions:

- Heating – a range of renewable sources including solar water heating, passive solar heating in buildings, geothermal and the use of biomass such as forest residues and fast-growing energy crops.
- Cooling – from biomass-powered systems or also solar cooling systems.
- Electricity – from wind power, small-scale hydro, geothermal, biomass, PV cells, tidal and wave power.
- Transport fuels – from liquid ethanol and biodiesel produced from plants.
- Chemicals – biofuels can provide a wide range of products currently based on oil and gas.

The natural flows of energy on planet earth provide a huge potential for harnessing carbon-neutral energy for society. Powered by the sun, the flows of wind power, hydro power, biomass, wave, tidal and solar heat and power – which can be captured by modern technology – are more than enough to provide for all our needs. The sun powers planet earth and allows us to survive. With smart technology it can also provide heat and electricity. It is also the driver for wind power. Wind in turn creates waves, a huge potential power source being tested worldwide in prototype schemes. The sun also powers the evapotranspiration cycle, which allows water to generate power in hydro schemes – currently the biggest source of renewable electricity in use today. Plants photosynthesize in sunlight and create a wide range of so-called biomass crops ranging from wood fuel to rapeseed, which can be used for heat, liquid fuels and electricity. Interactions with the moon produce tidal flows which can be intercepted and produce electricity.

Though humans have been tapping into renewable energy such as wood, solar and water power for thousands of years, so far we have managed to capture only a fraction of the technical and economic potential of renewables. The recent development of smarter and more efficient technology has been impressive. In the past 20 years these technologies have improved and costs have fallen dramatically. For solar photovoltaic (PV) cells, stimulated initially by the space programme, unit costs have fallen by a factor of 10 in the past 15 years. Onshore wind power at good sites can compete with traditional fuels, and modern biomass heating is invariably cheaper than oil heating [2].

While renewable energy technologies are often on a smaller scale than big fossil fuel and nuclear projects, they can be brought on-line quickly and with lower risks. Renewables already have a significant share in many countries. Denmark now gets 18 % of its electricity from wind power, and created an industry that has more jobs than the electricity sector itself. Spain has leapt from virtually nothing to become the second biggest wind power country in Europe with over 6000 MW of capacity. Countries such as Finland, Sweden and Austria have supported the development of very successful modern biomass power and heating industries through fiscal policies, sustained R&D support and synergistic forestry and industrial policies. As well as saving significant CO2 emissions, equipment from all three countries is now exported worldwide [3].

Renewable energy technologies are already available, but not used enough.

If all countries would focus on renewables in the same way as the most successful countries in terms of renewable energy technologies growth rates, the results would be impressive.

Renewable energy technologies do have an impact on the environment, as do all energy technologies. However, the relative impacts of renewables are far less than those of fossil fuels and nuclear power. A major EU study concluded that when climate change and the possible impact of catastrophic accidents of nuclear plants are taken account of, renewables have a significantly lower environmental impact.

Thus, in conclusion it should be mentioned that renewable energy should no longer have the alternative tag – it is a mainstream set of energy options able to provide cost-effective and reliable low-carbon energy. After extensive R&D and commercialization over the past 20 years, wind power, biomass heating and power, solar heating and power and the other renewable energy options are important elements of the modern energy mix. Renewable energy has some different characteristics to fossil fuels and nuclear power. Some of the technologies offer more intermittent power, and are less concentrated than oil or uranium. Taken as a group however, and utilizing modern energy grids and networks, renewable can be integrated to provide predictable and reliable energy solutions.

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Environmental impact of the smart grid

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The Green Smart Grid Initiative.

Few issues are getting more attention within the energy industry and among policymakers these days than the smart grid and climate change. Yet most do not see these two areas as being connected. More precisely, the smart grid – and smart grid practices like demand response – is not being viewed as having a role in the attainment of climate change goals [4].

The Green Smart Grid Initiative (GSGI) is an effort to demonstrate that the smart grid indeed can be a major positive force in addressing climate change. Among the issues it seeks to help parties gain an understanding of are the following:

1. **Smart Grid and Renewable Energy;**
2. **Smart Grid and Energy Efficiency**

1. Energy Efficiency.

Major building block in plans to address climate change is energy efficiency. Most energy efficiency efforts are focused on replacement of devices and equipment with more efficient items, or focused on energy efficient design and labeling of products and buildings. The smart grid introduces and fosters new types of energy efficiency by allowing the operation of the electricity system to be dynamically optimized at all times. Also, and importantly, the smart grid does not stop at the customer's meter. It provides customers with new pric-

ing and billing options and stimulated be more efficiency. The latter has been shown to spur customers to take actions to be more energy efficient overall in their electricity usage [4].

New figures from Bloomberg New Energy Finance show 7% growth in global smart grid investment in 2012. The company expects just over 10% compound annual growth for the next five years, nearly doubling the market to $25.2bn per annum by 2018.

London and New York, 24 January 2013 – Utilities worldwide spent $13.9 bn in 2012, up 7% on the previous year, on smart grid technologies such as advanced metering and fault management, according to figures released today by research company Bloomberg New Energy Finance.

Roughly half of the total – $7.1bn – was spent on smart metering and related infrastructure and services. The next biggest category was distribution automation, followed by integrated demonstration projects in areas such as demand response, home energy management and smart electric vehicle charging [3].

2. Renewable Energy.

Some engineers think that the increasing use of renewable energy is a key component of any strategy and plan for addressing climate change. What is less known is that many renewable energy options provide power on an intermittent and variable basis or do not deliver power at times of peak demand – when the demand for power is greatest and emissions can be higher than average. By using smart grid technologies, and smart grid practices like demand response, the electricity system can accept and manage the amount of renewable energy that policymakers and the renewable energy industry desire and expect to be developed [4].

The National Renewable Energy Laboratory's (NREL) Renewable Electricity Futures Study (RE Futures) is an initial investigation of the extent to which renewable energy supply can meet the electricity demands of the continental United States over the next several decades. This study explores the implications and challenges of very high renewable electricity generation levels –from 30% up to 90%, focusing on 80%, of all U.S. electricity generation –in 2050. At such high levels of renewable electricity generation, the unique characteristics of some renewable resources, specifically geographical distribution and variability and uncertainty in output, pose challenges to the operability of the nation's electric system.

Key Findings.

Renewable electricity generation from technologies that are commercially available today, in combination with a more flexible electric system, is more than adequate to supply 80% of total U.S. electricity generation in 2050 while meeting electricity demand on an hourly basis in every region of the country.

Increased electric system flexibility, needed to enable electricity supply and demand balance with high levels of renewable generation, can come from a portfolio of supply- and demand-side options, including flexible conventional generation, grid storage, new transmission, more responsive loads, and changes in power system operations.

The abundance and diversity of U.S. renewable energy resources can support multiple combinations of renewable technologies that result in deep reductions in electric sector greenhouse gas emissions and water use.

The direct incremental cost associated with high renewable generation is comparable to published cost estimates of other clean energy scenarios. Improvement in the cost and performance of renewable technologies is the most impactful lever for reducing this incremental cost [2].

Emissions.

By increasing the use of renewable energy and energy efficiency, the smart grid will lead to a major decrease in the carbon emissions that are leading to global climate change. It will also increase other types of efficiency that lead to additional CO2 reductions. Below you

will find some facts relating to the contribution that the smart grid can make to reducing carbon emissions. The Smart Grid can reduce emissions by 60 to 211 million metric tons of CO2 a year by 2030. Basis data you can see in the **Table 1**. The Smart Grid helps reduce emissions by managing electricity peak load. CO2 emissions on peak can be 230% higher than off peak [4].

Table 1. Basis for Direct Energy/Carbon Reduction Estimates

Direct Reduction Mechanism	Reduced Energy Consumption (2030)			
	Est	Low	High	Baseline Energy Consumption End Use Sectors
Conservation Effect of Demand Response Consumer Information	6	1	10	Residential
	6	1	10	Sm./Med. Commercial
Measurement and Verification for Efficiency Programs: Marginal Efficiency Measures Enabled by Acurate M&V	7	5	20	Residential (Heat Pump & AC)
	7	5	20	Sm./Med. Commercial (HVAC+ Lighting)
Smart Grid-Enabled Diagnostics in. Residential and Small/Medium Commercial. Buildings	15	10	20	Residential (Heat Pump & AC)
	20	10	30	Sm./Med. Commercial (HVAC+ Lighting)
Conservation Voltage Reduction and Advanced Volt/VAr Control	2	1	4	Total Electric Supply
Load Shifting from Demand Response	0.04	0.02	0.06	Total Electric Supply
Support Additional Electric Vehicles (EVs) /Plug-In Hybrid Electric Vehicles (PHEVs)	3	2	5	Light Vehicle Transportation (cars, vans, SUVs, light trucks)
Solar Photovoltaic Integration (20% RPS):Reduced Energy for Regulation	(Note: Estimates for extra regulation required for meeting a 25% RPS with solar PV integration are not available, but may be similar to that for wind. If so, and PV is used instead of wind, or to supplement it, in meeting a 25% RPS requirement, the savings are already included in the estimates for wind integtration.)			
Wind Energy Integration (20% RPS):Reduced Energy for Regulation	20	10	30	Additional Regulation

Climate Impact.

Climate change will have a major impact on the electric grid. Rising temperatures will lead to increased air conditioning use, stressing the grid during times of peak demand. Severe weather may destroy air grid. Smart grid technologies such as synchrophasors, advanced control and monitoring equipment, and smart meters will make the electric system better able to respond to the impacts of climate change, whether it is through preventing power outages, speeding up outage restoration times, or limiting peak demand through demand response.

Between 2003 and 2012, weather-related outages are estimated to have cost the U.S. economy an inflation-adjusted annual average of $18 billion to $33 billion. Continued investment in grid modernization and resilience will mitigate the costs of weather-related outages over time. These investments may include installing smart grid technology such as smart meters, outage management systems, synchrophasors, and advanced control capabilities [1].

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Arrangement and functional concept of a gas-fired power plant

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Gas is a major source of electricity generation. Approximately 21% of the world's electricity production is based on natural gas. The global gas-fired generation capacity amounts to 1168 GW_e (2007). The combustion (gas) turbines being installed in many of today's natural-gas-fueled power plants are complex machines, but they basically involve three main sections:

- **The compressor**, which draws air into the engine, pressurizes it, and feeds it to the combustion chamber at speeds of hundreds of miles per hour.
- **The combustion system**, typically made up of a ring of fuel injectors that inject a steady stream of fuel into combustion chambers where it mixes with the air. The mixture is burned at temperatures of more than 2000 degrees F. The combustion produces a high temperature, high pressure gas stream that enters and expands through the turbine section.
- **The turbine** is an intricate array of alternate stationary and rotating aerofoil-section blades. As hot combustion gas expands through the turbine, it spins the rotating blades. The rotating blades perform a dual function: they drive the compressor to draw more pressurized air into the combustion section, and they spin a generator to produce electricity.

There are two types of gas-fired power plants, viz. open-cycle gas turbine (OCGT) plants and combined-cycle gas turbine (CCGT) plants. Open-cycle gas turbines (OCGT) for electricity generation were introduced decades ago for peak-load service. Simple OCGT plants consist basically of an air compressor and a gas turbine aligned on a single shaft connected to an electricity generator. Filtered air is compressed by the compressor and used to fire natural gas in the combustion chamber of the gas turbine that drives both the compressor and the electricity generator. Almost two-thirds of the gross power output of gas turbine is needed to compress air, and remaining one-third drives the electricity generator. OCGT generators have relatively low electrical efficiency ranging between 35% and 42% (lower heating value, LHV). Aero-derivative gas-turbines provide efficiency of 41-42% but their size is limited to 40-50 MW_e.

Since theearly 1990s, combined-cycle gas turbines (CCGT) have become the technology of choice for new gas-fired power plants. CCGT plants consist of compressor/gas-turbine groups – the same as OCGT plants – but the hot gas-tubine exhaust is not discharged into the atmosphere. Instead it is re-used in a heat recovery steam generator (HRSG) to generate steam that drives a steam-turbine generator and produces additional power. Gas-turbine exhausts then leave the HRSG at about 90˚C and are discharged into the atmosphere. CCGT plants commonly consist of one gas turbine and one steam turbine. Approximately two-thirds of the total power is generated by gas turbine and one-third by the steam turbine. Large CCGT power plants may have more than one gas-turbine.

State-of-art CCGTs have electric efficiency of between 52% and 60% (lower heating value, LHV) at full load. Combined-cycle gas turbine is mature technology. It is one of the dominant options for both intermediate load (2000 to 5000 hrs/yr) and base load (>5000 hrs/yr) electricity generation. In the last decade, many CCGT plants have been built in North America, Europe, Asia, and the Middle East. These plants have become the workhorses of independent power producers all over the world. With individual heavy-frame gas turbines available in unit sizes of up to 300 MW_e CCGT plants offer modular flexibility and adaptability to the electricity demand and grid requirements. In general, gas-turbines can burn not only natural gas but also heavy/crude oil, distillate and other liquid and gaseous fuels. Obviously, large heavy-duty gas-turbines with big combustion chambers are more suitable for burning heavy fuels, while small, aero-derivate gas-turbines, with several little burners or combustion chambers, are more sensitive to changes of combustion parameters. In general, CCGT plants are designed to respond relatively fast to changes in electricity demand and service. They may be operated between 40% and 100% of nominal capacity with moderate efficiency drop (58-59% at full load to 50-52% of the full load). Due to the high efficiency and the use of natural gas, the best available CCGT power plants emit approximately 50% less CO_2 and up to nine times less NO_x per kWh than modern coal-fired power plants.

One key to a turbine's fuel-to-power efficiency is the temperature at which it operates. Higher temperatures generally mean higher efficiencies, which in turn, can lead to more economical operation. Gas flowing through a typical power plant turbine can be as hot as 2300 degrees F, but some of the critical metals in the turbine can withstand temperatures only as hot as 1500 to 1700 degrees F. Therefore, air from the compressor might be used for cooling key turbine components, reducing ultimate thermal efficiency.

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Power converters

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Power converters are devices designed to convert electric energy parameters (voltage, frequency, number of phases, waveform). Power converters are used in electrical engineer-

ing, power engineering and the electric power industry. Power converters are composed of semiconductor devices, since they provide high efficiency. Table 1 below outlines component base of power converters.

Table 1. History of converters components

Period of use	Component base
1880	Motor-generator (umformer), Still are used (dinamotor), albeit limited
1880	Transformers
1930-1970	Ionic devices (ignitron)
1960-2014	Semiconductor diodes, thyristors and transistors

Often, the emergence of new devices does not eliminate the need to use a number of instruments that existed before. For example, many semiconductor devices use transformers, but in a better high-frequency range. As a result, the device acquires the benefits of both devices.

One way of classifying power conversion systems is based on converting alternating current (AC) into direct current (DC) or direct current into alternating current. These properties are used in such power converters as inverter and rectifier.

Functions of converters:

- conversion,
- transformation and regulation,
- transformation and stabilization.

Rectifier – a device for converting AC power source into DC. They are used in urban transport systems, such as trams, trolleybuses. Inverter – the device, whose task is the inverse rectifier converting DC to AC power. Inverters are used in solar and wind-diesel power stations.

Inverters are divided into two classes: the slave, or dependent network and autonomous.

Dependent inverters.

Slave inverters convert DC power into AC to return it to the AC mains that is carried out the transformation inverse rectifier.

Stand-alone inverters.

Stand-alone inverters are devices that convert direct current into alternating with constant or variable speed and run on stand-alone (not connected to AC power) load.

By the change in level voltage converters are divided into voltage stabiliser, linear regulator, transformer or autotransformer, voltage converter, voltage regulator. This equipment is used in various systems of electricity: atomic power station, solar power plant, wind power station, hydro power plant. And the final classification is based on the change in frequency. They are called variable-frequency transformers or converters of frequency. Frequency converters are used in the DC drive.

Power converters play an important role in the electric power industry and in the DC/AC drive. Thanks to the power converters, mankind has made a big step forward in its development and improved our lives.

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Power systems with improved energy performance

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This article focuses on reduction of the power factor. It presents the research of power supply with improved energy performance taking a reverse thyristor converter as an example.

Definition of active and reactive power has an obvious physical meaning for circuits with a sinusoidal voltage and current. Active power P characterizes fraction of the instantaneous power (s = ui) which can be converted into other forms of energy (thermal, mechanical, chemical, electromagnetic and others). Reactive power Q characterizes the exchange energy between the source and the load, which loads the circuit (it creates interference) but it can't be used useful. Vector sum of active and reactive components of the current (voltage) in a circuit leads to a geometric addition of active power P and reactive power Q in the resulting power called the apparent (full) power: $S = \sqrt{P^2 + Q^2}$.

Full power is a calculated value that characterizes the resource costs of device implementation. In other words, full power characterizes the total cost (in a scale) resources (copper, steel, insulation and so forth) for the implementation of this device.

Determination of the total power is significantly complicated when energy processes of a circuit are non-sinusoidal. Nonsinusoidal processes arise due to the presence of non-linear elements in the load. This leads to appearance of higher harmonics in the current and voltage waveforms.

It is known, that useful work in a load can be performed only by the power which is carried by the first harmonic. All harmonics transfer power, which, as well as reactive power Q, characterize the energy exchange between the source and the load. This energy can't perform useful work in load, but its physical nature completely differs from the physical nature of reactive power Q.

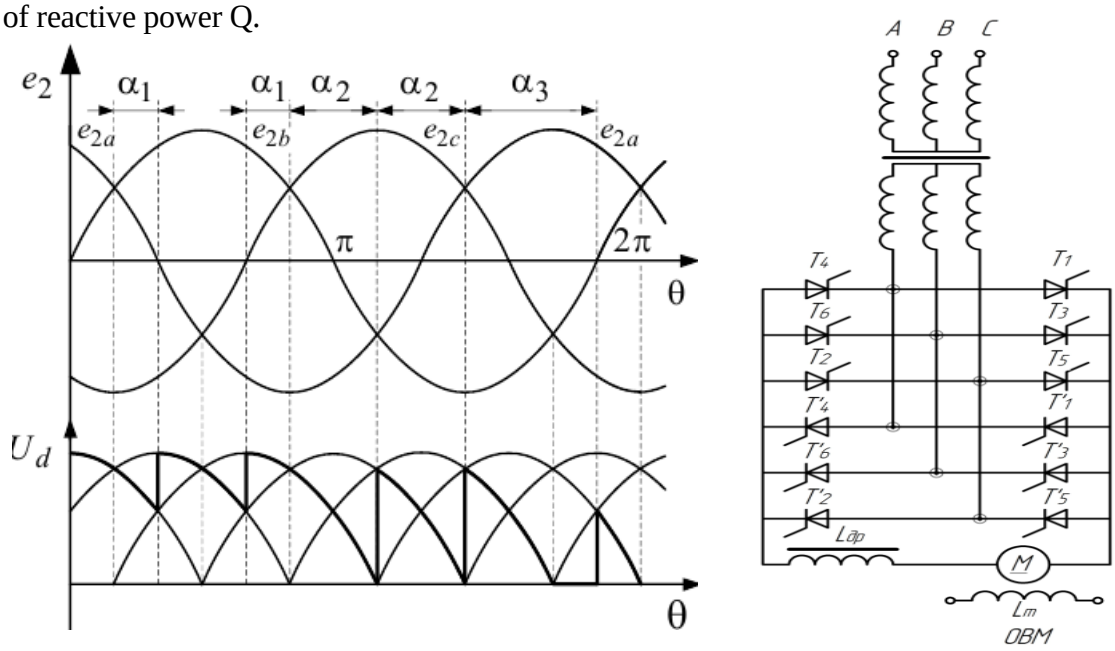


Figure 1 – Three-phase bridge anti-parallel circuit and a diagram explaining the operation of the scheme.

Voltage unbalance in three-phase circuits with non-uniform loading phases provides a similar impact on the mains supply. It leads to a considerable complication of determining the total power and estimation of the influence of electrical installations in networks.

At present, the evaluation of the negative impact of these factors in the supply mains is carried out by using the full power factor. It is the ratio of active power PA and apparent power S: $\chi = P_a / S$.

Full capacities consider not only the active P and reactive power Q, but also distortion power T, which is carried by higher harmonics, and unbalance power N, which is carried by the reverse sequence and zero sequence of currents: $S = \sqrt{P^2 + Q^2 + T^2 + N^2}$.

Today the problem of harmful effects reduction at electrical installations in supply networks is an important task in the global electrical engineering because it is a very important economic problem.

The power section of conversion device is a reverse thyristor rectifier which is made by a three-phase bridge circuit. Also it includes a power (matching) transformer, control system and protection system of the drive. Rectifiers connect antiparallel, power kits are separately controlled (Figure 1).

Anti-parallel circuit with close-coupled thyristor groups is the most promising circuit with separate management. This design significantly reduces the size reversible converter.

Influence of electric power systems to the thyristor converter is shown by the distortion of current and voltage of synchronous generators, increase of additional losses in generators, induction motors, transformers, trouble with the automatic and computing machinery, network loads by additional reactive power and distortion power, reduction of the power factor.

Network impact on the thyristor converter increases the harmonics of the rectified voltage, reduces stiffness characteristics of the external transducer malfunction, control systems of a thyristor converter.

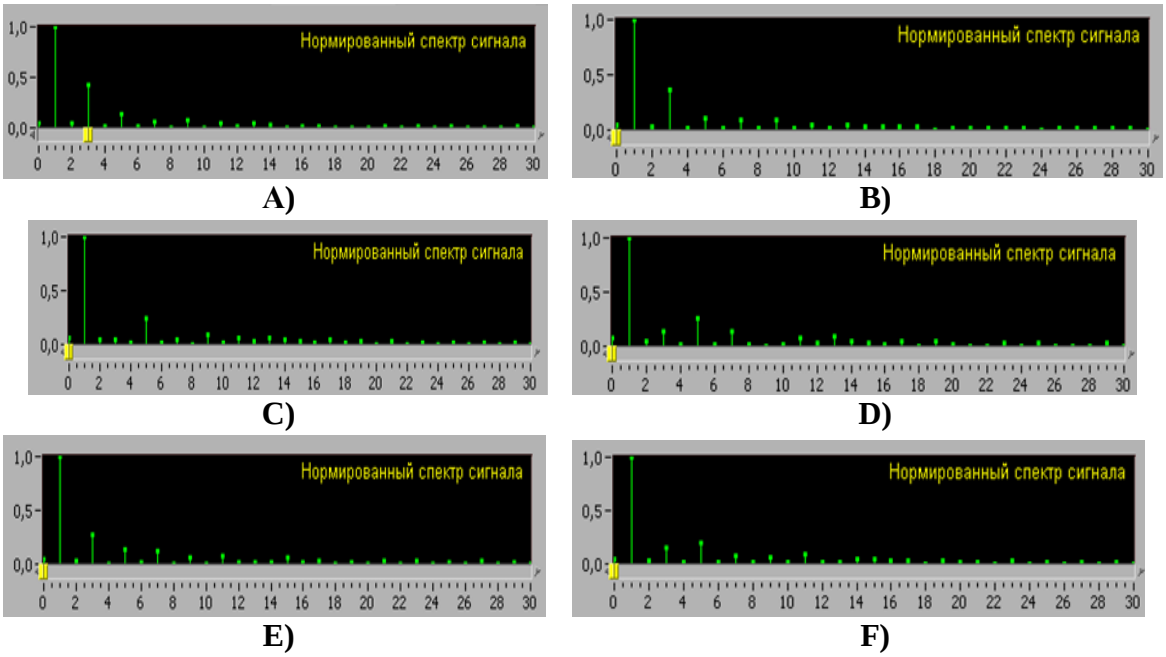


Figure 2 – The amplitude spectrum of input control current harmonics for angles A) α=10°, B) α=20°, C) α=30°, D) α=40°, E) α=50°, F) α=60°.

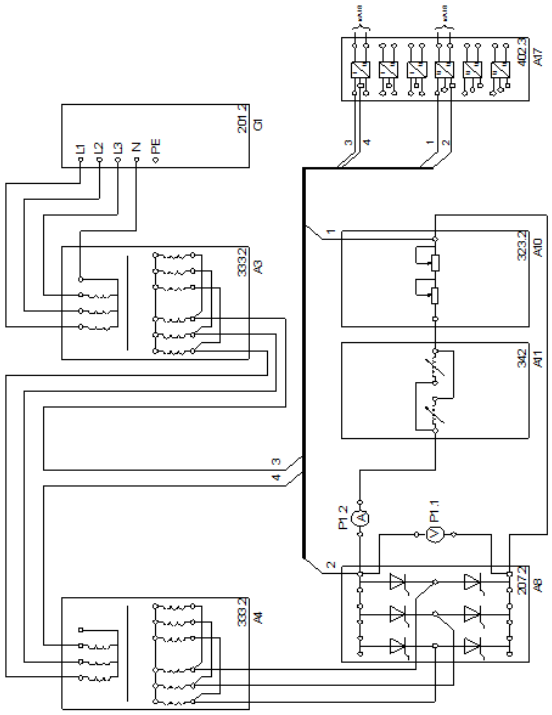


Figure 3- Electrical scheme.

When the primary windings are connected in a triangle, diagram magnetically balanced. Therefore, the primary windings of converter transformers expedient to combine into a triangle (Figure 5).

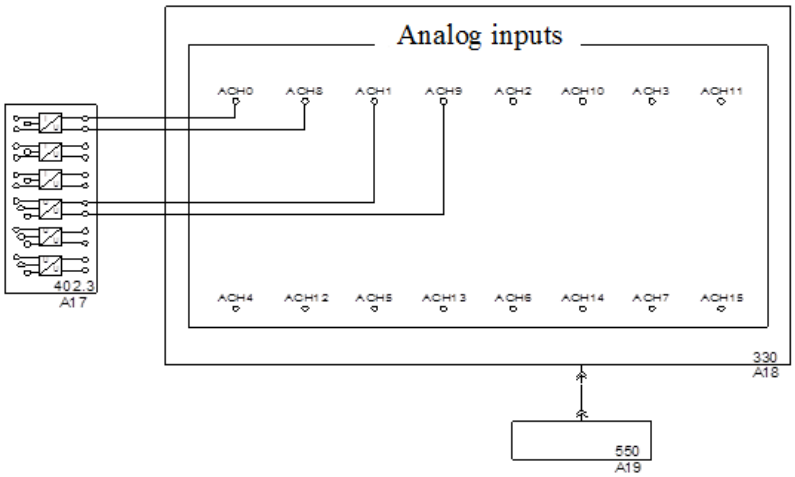


Figure 4 – Electrical scheme.

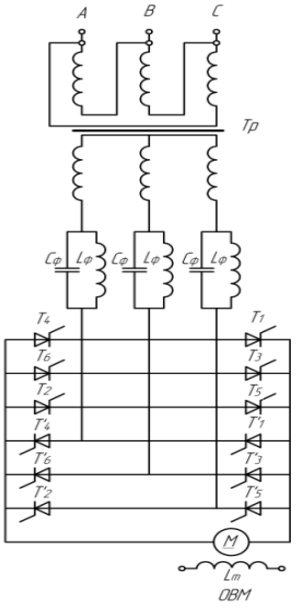


Figure 5– Controlled three-phase bridge rectifier with LC-filter.

Experiment

It is necessary to determine the harmonic composition of the rectified voltage and current of a three-phase bridge, which is controlled by a rectifier, that works with an active-inductive load (Figures 3,4).

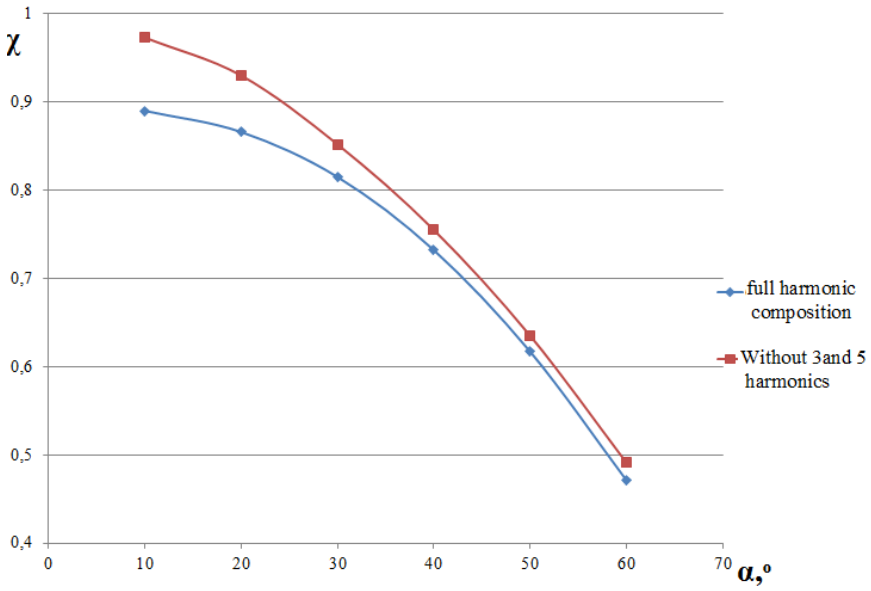
Amplitude spectrum of harmonics current consumption for different angles control α was defined. Results are presented in Figure 2.

Odd harmonics (3, 5 and 7) have most powerful influence on the operation of the converter. The third harmonic can be significantly reduced by the schematic. If the primary windings are connected in a triangle, then all the harmonics in the secondary currents are transformed curve from the secondary windings in the primary. At the same harmonics with a serial number, which are multiples of three, closed inside the triangle of primary windings and do not penetrate into the mains supply.

The fifth harmonic can be greatly reduced by using a parallel LC – filter tuned at 5 harmonics in each phase of the transformer secondary winding.

Resonance occurs in a parallel resonant circuit with the resonance condition current when the current in the inductance and capacitance filter equal in magnitude and opposite in phase. As a result, the resulting harmonic current is zero (Figure 5).

7 harmonic also has a significant impact on the operation of thyristor converter. However, its removal is not economically viable, as it would require the installation of another filter. The installation of the filter will take more money than could have been saved in eliminating harmonic 7. The power factor χ for different control angles was calculated.



According to this graph shows that the power factor is significantly improved, especially for control angles α = 10 ° ÷ 30 °. The obtained results are fully consistent with the theory.

Figure 6 (left) – Dependence χ=f(α).

Verification

An experiment was conducted and 3 harmonics have been removed. Amplitude spectrum of harmonics current consumption for different angles control α was defined. Results are presented in Figure 7.

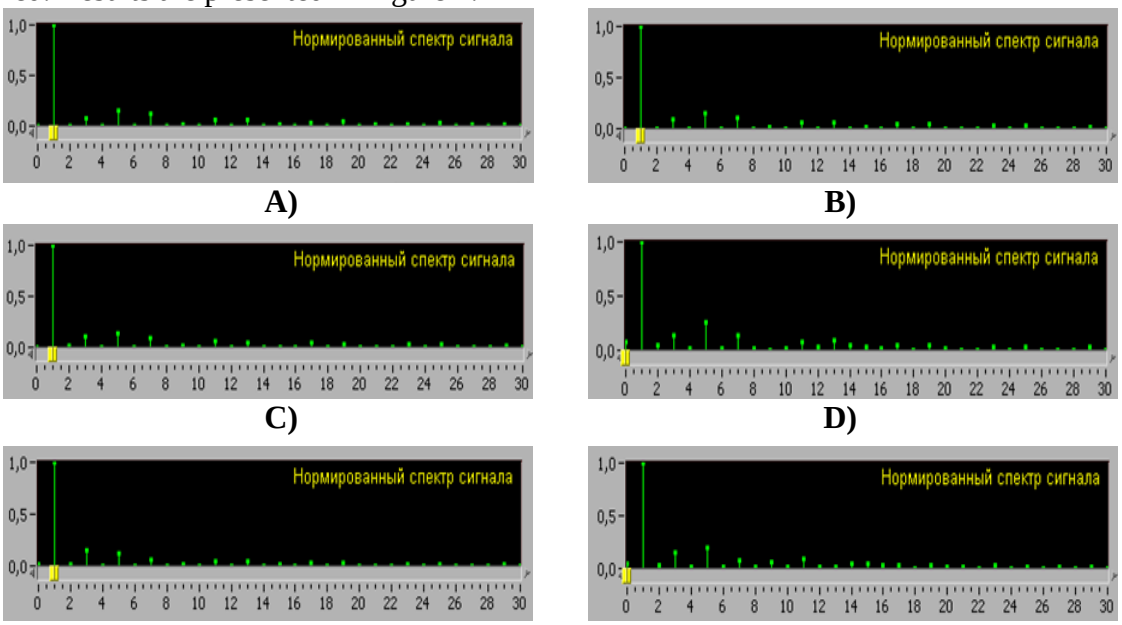
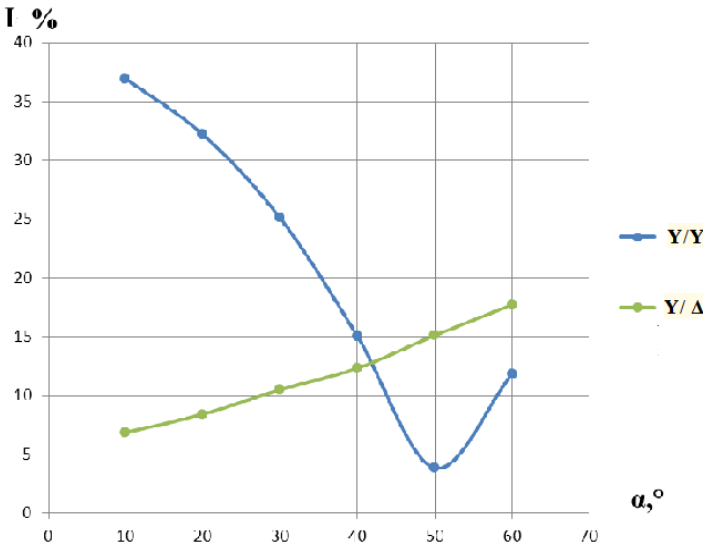


Figure 7 – The amplitude spectrum of input control current harmonics for angles A) α=10°, B) α=20°, C) α=30°, D) α=40°, E) α=50°, F) α=60°.

From the results it can be seen that the dependence of the third harmonic is greatly diminished. Theoretically, the third harmonic should be zero when it connects the transformer primary winding in a triangle, but in practice, due to the switching processes the third harmonic can't completely disappear.

This article describes the measures taken to reduce the impact of higher harmonics of the frequency converters. Thus, the third harmonic is substantially reduced by the schematic, connecting the primary windings of the transformer in the triangle. All data of theoretical calculations were verified experimentally, the amplitude of the third harmonic is really noticeably diminished. Fifth harmonic has been significantly reduced by parallel LC – filter,



which is tuned to the frequency of the 5 harmonic. Problem of energy saving is one of the most important moment in the world. Therefore, improving the power factor can significantly reduce the loss of electricity.

Figure 8 (left) – Dependence of the percentage of the third harmonic on the input current from the control angle α.

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Power apparatus and systems malfunction diagnostic on the basis of its own electromagnetic emission analysis

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With the modern strategies development in order to organize the main electrical substation equipment, power lines maintenance and repair there appears so called "on-condition" [1] repairs concept. In this respect, technical diagnostics becomes extremely important in any industries. The Economic Effect of high voltage equipment diagnosis is associated with its ability to determine the current technical condition and equipment residual life for detecting defects at an early stage of their development and the really required repair works. Nowadays there are a lot of different technical diagnostics methods but the most preferable are the automated methods of controlling the state of the energized equipment [2-4].

One of the perspective diagnosis methods that are able to determine the technical state of the object and track the defects dynamics is to analyze the changes in the electrical equipment electromagnetic radiation.

The main idea of this work is to study autotransformer technical state via spectral analysis of the electromagnetic radiation changes.

Problem Statement:.

1. Get an array of diagnostic information about the object electromagnetic field;.
2. Create the data processing algorithm;.
3. Identify diagnostic feature of the defect specific type.

The idea of monitoring frequency high voltage equipment electromagnetic radiation is based on the revealed electrical discharges manifestations intensity from increasing insulation degradation and the defects appearance in structural elements.

Equipment technical condition assessment is based on the high-frequency component spectral analysis of the electromagnetic radiation signal that has a number of distinct advantages over usual methods.

- data about the defect appears at a very early stage of its occurrence when it is impossible the register it by any other methods.
- in the high frequency area is almost impossible to tune out noises, which are the corona discharges (CR) source, superficial partial discharge (PD), high-frequency communication, etc.
- techniques development is possible with extensive capabilities in terms of the both internal and external equipment defects registration.

CR, as well as the surface PD duration is usually ten nanoseconds or more, while the duration of the current flow in the PD internal insulation is a few nanoseconds. Natural electromagnetic radiation emitters are elements of the equipment design which essentially act as the dipole antennas. Taking into consideration these antennas characteristics and their resonance frequencies allows us to specify the defect location. Thus, the upper part of its own electromagnetic radiation can be divided into sections specific to the individual radiation sources. Pulses from discharges have different amplitudes and time constants, so the electromagnetic spectrum due to a pulses series is polymodal.

Transformer diagnosis device consists of the electromagnetic radiation receiving antenna, input connector, I / O board, laptop. The object of study is autotransformer ATDCTN 500000/500/220 located in Kazakhstan hydroelectric power station.

Information about the defects presence in autotransformer insulation windings should immediately appear in the registered electromagnetic field spectrum.

Radiating elements are the structures isolated from the grounded tank high voltage bushings, discharges, enclosed in insulators conductors, etc. In our case, the radiating antenna input is 500 kV, 220 kV and power groung.

Inputs dimensions acting as radiating conductors are: 4.24 m., 2.72 m. and 0.59 m.

Inputs in this case are radiating antennas with resonant frequencies of the radiation level.

$$(f_{pi})_n = nc / (4h_i),.$$

at i = 1, 2, ..., i_{max} – input; n = 1, 2, 3, ... is the number of harmonic Fourier series; c – light velocity in m/s; h_i – height of the i-th input, m.

Useful information possess bandwidth (Δf_p) n which can be defined as (Δf_{pi}) n = $(f_{pi})_n$ / Q_{in}, at Q_{in} – the equivalent Q factor of the antenna being in the range 2 to 5.

Table 1 shows informative frequency bands for the first resonant frequency of 500 kV autotransformer bushings.

Table 1. Range of frequencies and frequency bands for the information of 500 kV autotransformer.

Input №	Inform. frequency band width in MHz	Frequency band boundaries in MHz	The main resonance frequency in MHz
Input 1, 500 kV	$(\Delta f_{p1})_1$=5	от 15,2 до 20,2	$(f_{p1})_1$=5
Input 2, 220 kV	$(\Delta f_{p2})_1$=8	от 23,6 до 31,6	$(f_{p2})_1$=8
Input 3, power ground	$(\Delta f_{p3})_1$=36	от 110 до 146	$(f_{p3})_1$=36

Monitoring procedure is as follows:

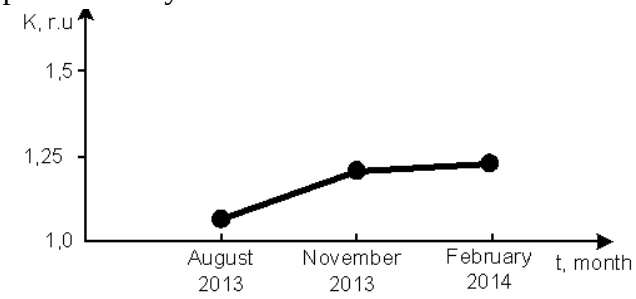
1. Incoming inputs definition.
2. Resonance frequencies emitting antennas calculation.
3. Informative frequency bands for the first resonant frequency determination.
4. Resonance frequencies and informative frequency bands for the higher harmonics calculation.
5. Electromagnetic waves integral power factor determination.
6. Equipment assessment.

As a receiver, it is desirable to use standard industrial receiver with integrated analog-digital converter and microprocessor, enabling them to handle with the electromagnetic waves energy spectrum in the desired frequency range.

The equipment assessment for the integrated power factor electromagnetic oscillations is calculated in a given informative band. Integrated power factor K_n of the spectrum qualifying characteristics is the most revealing and is determined for each n-th informative frequency band as the ratio of the integrated power to the equipment $P_{n.\text{monit}}$ reference to the integrated power $P_{n.st}$:

$$K_n = P_{n\ monit} / P_{n\ st},.$$

at $P_n = \int_{f_{n.\min}}^{f_{n.\max}} S_n^2(f)df$ – equipment integral power factor; $S_n(f)$ – integrated radiation power density.



The figure 1 shows integral power factor changes during 6 month period. As you can see it describes the stable operation of the equipment that the variation coefficient ranging from 1.06 to 1.23. These data is confirmed by the regulatory tests results.

Fig.1 Integral power factor changes.

In conclusion it is necessary to add that the electromagnetic emission analysis can serve as the basis for technical diagnostics creation. The high-voltage equipment assessment criteria can be the integral radiation power and integral power factor.

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Supercritical water reactor

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INTRODUCTION

Current scenarios predict a global demand for electricity 2-3 times higher in the next 50 years compared to nowadays. Today there are about 440 nuclear power reactors operating in 30 countries, most of which will exhaust their resources by 2050. If nuclear's energy share of the worldwide energy production will remain unchanged at a level of 14%, at least 1,000 nuclear reactors would have to be built.

Thus in 2001, nine countries (Argentina, Republic of Korea, Brazil, Canada, Republic of South Africa, United Kingdom, France, United States and Japan) signed the founding document of Generation IV International Forum (GIF) in order to develop nuclear systems that can fulfill the increasing world electric power needs.

SCWR

Currently, there is a number of Generation IV SCWR concepts under development worldwide. It is a high-temperature, high-pressure water-cooled reactor that operates above the thermodynamic critical point of water (above 374°C, 22.1 MPa). The main advantage of the SCWR is improved economics due to increase in thermal efficiency from 30 – 35% to approximately 45 – 50%. Moreover, the use of a high-temperature, single-phase coolant allows to simplify plant's operations and lower expenses by decreasing its electrical-energy costs [1].

SCWR DESIGN OPTIONS

The reactor core may have a thermal or a fast-neutron spectrum, depending on the core design. The concept may be based on current pressure vessel or on pressure tube reactors, and thus use light water or heavy water as a moderator. It opens the way for a number of concepts.

LIGHT WATER REACTOR

The SCWR concept was developed at the University of Tokyo in 1989 and became a global concern after being selected by the Generation IV International Forum in 2002. It's Pressure-vessel, since 1989 (thermal version) and 2005 (fast version) [2].

CANDU-SCWR

Another concept proposed by Canada is generically called CANDU-SCWR, It is a pressured tube type reactor with fuel channels separating the light water coolant from the heavy water moderator [2].

CONCLUSION.

Nuclear energy systems are essential to meet the world's growing energy demand while providing competitively-priced and reliable energy in a safe and sustainable way.

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Radioactive waste vitrification

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As the world fossil fuel reserves diminish, alternate energy sources will become increasingly important. One of the most commonly discussed forms of alternative energy is nuclear power. Although there are a number of pros and cons to nuclear power generation, one aspect that has received some attention in the news over the past few years is the long-term storage solutions for nuclear waste from both past, current, and future productions.

Nuclear Waste

Nuclear waste currently in storage comes from three principal sources: spent fuel from commercial or research reactors, liquid waste from the reprocessing of spent fuel, and waste from the nuclear weapons and propulsions industry. Most of the storage concerns relate to so-called 'high level' nuclear waste, which are highly radioactive, require cooling and containment because their decay gives off heat and radiation, and have an extremely long half-life. In particular, some radioactive isotopes such as Tc-99, Se-79, and I-129 are mobile in water, requiring a storage solution that reduces their ability to move into the groundwater.

In the US, most nuclear waste storage is temporarily done on site. Spent nuclear fuel is kept in pools of recirculated water to keep it cool while the increased radioactivity dies down before it either reprocessed to recover the plutonium or kept in dry storage for eventual deposit into a geological repository. For the nuclear waste resulting from weapons development, the majority of the waste is stored at the Hanford site in southeastern Washington, where the plutonium for the US weapons was produced. Much of the waste there is stored in 177 buried tanks as a combination of both high-level and low-level liquid waste. These tanks were never intended for long-term waste storage and several are known to be leaking.

Vitrification

The desired long-term storage form for nuclear waste is a relatively insoluble, compact solid. As a solid, the waste becomes easier to store and handle; a small volume is desired because there are likely to be few candidates for long-term storage spaces and thus space will be at a premium. Keeping the solubility low reduces the chances of groundwater contamination. The resulting solid is then likely to be packaged, which provides additional barriers to contamination of the environment, but the effects of radiation on the surrounding matrix packaging are not negligible.

Amorphous borosilicate's have been identified as one option for nuclear waste storage forms. To produce the glass, the waste is dried, heated to convert the nitrates to oxides, and then mixed with glass-forming chemicals and heated again to very high temperatures (approximately 1000 °C) to produce the melt. This is then poured into a containment vessel where it cools to form a glass. The containment vessel can then be sealed, decontaminated,

and placed into a long-term (or temporary) storage facility. Studies of archeological glasses have agreed with models showing the immobilization of the important mobile nuclides during the critical time period where they are highly radioactive, encouraging the continued study and use of this methodology. This process is used to prepare waste for storage at a number of nuclear power plants in Europe.

Growing Need

Although much of the work has focused on cleanup and storage of nuclear waste already present, it is clear that as more nuclear plants are added there is an increased need for waste storage capacity and eventually a long term storage location. Vitrification continues to be studied as a long term treatment plan, but the glass produced is still radioactive and needs to be stored somewhere.

For a 1000 MW plant, 30 tonnes of high level nuclear waste are produced a year. With 104 nuclear plants of roughly that size in the US, this produces 3120 tonnes of high level nuclear waste a year in the US alone. Multiple the number of nuclear plants by 5 to compensate for all the natural gas plants, for example, and the nuclear waste issue scales as well. In comparison, the abandoned Yucca Mountain Nuclear Waste Storage Repository was only planned to hold 77,000 tonnes of material, all of which is currently stored elsewhere. Even if the storage facility was not required for any of the currently existing waste, the current rate of high level nuclear waste production would fill the facility in 24.7 years, excluding any increases in capacity.

While nuclear power may prove to help alleviate the upcoming energy crisis, it becomes apparent that while some of the challenges relating to the storage of nuclear waste may have been solved, there are still major issues that remain before increased capacity becomes a viable solution over the long term.

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Das ataktische Polypropylen in der Energetik

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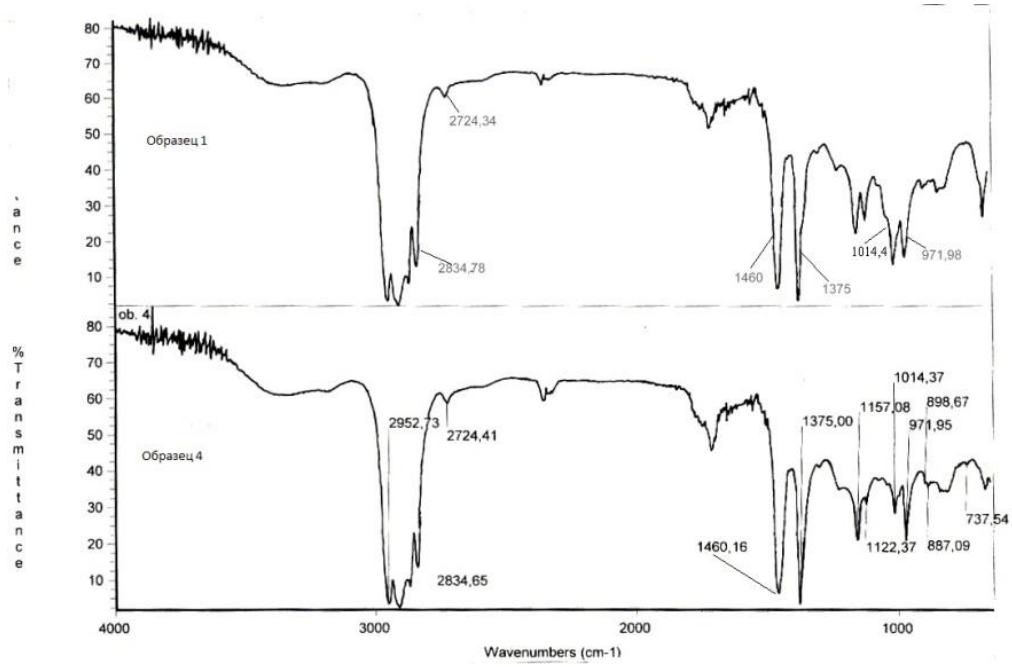
Das Wasser ist ein Hauptzerstörer der metallischen Konstruktionen. Besondere Gefahr stellt das Erfrieren des Wassers vor. Das Eis, das sich in den Kapillaren der Poren bildet, hat einen großen Umfang, deshalb im Material entstehen die starken mechanischen Anstrengungen.

Das ataktische Polypropylen ist ein wasserfestes Material. Das ataktische Polypropylen ist ein ganz einzigartiges wasserisolierendes Material. Es ist bei der Bearbeitung der Oberfläche des Betons, des Metalls zwecks der Verhinderung der Durchdringung der Feuchtigkeit in die Konstruktionen der Stromversorgungen, bei der Elektroisolierung der abgesonderten energetischen Knoten, bei der oberflächlichen Bearbeitung der elektrischen Leitungen zwecks der Verhinderung ihrer Vereisung (1, 2) effizient.

Die Zeichnung 1 zeigt die Erforschung des ataktischen Polypropylens mit Hilfe der Methode der Spektroskopie.



Die Zeichnung 1. Die Spektren des ataktischen Polypropylens.

Im Spektrum des abgeänderten Musters kann beobachtet werden, dass die die relative Intensität des Streifens der Absorption bei 720 cm-1 (die Pendelschwingungen der S-S-Verbindung in die Gruppen (CH2) vergrößert wird, was zusammen mit der Verkleinerung der relativen Intensität des Streifens der Absorption auf dem Gebiet 1376 cm-1 (die Deformationsschwingungen der Gruppen (CH2)) von der Anwesenheit der Ketten zeugt, die sich zwischen der Methyl-Gruppe und der Hauptkette in Form der Alkyl-Abzweigungen befinden [5,6,7. Die Haupteigenschaften des Ausgangs- und abgeänderten Polymers sind in der Tabelle 1 dargestellt.

Tabelle 1

Parameter	Anfangs	nach der Oxidation	
		180˚C,2 u.	250˚C,6 u.
$M_\eta \cdot 10^{-3}$	36,0	29,0	5,0
M_W/M_n	5,5	7,0	11,0
Anteil die Carbonylgruppen, %	0,0	0,29	0,95
Anteil die Verunreinigungen, %	14,0	2,0	0,5
Die Eindringtiefe der Nadel 25˚C, 0,1 mm	112,0	99,5	96,5

Die Ergebnisse der Forschungen (die Adhäsionseigenschaften in der Oberfläche der Materialien, die in den Konstruktionserzeugnissen der Energetik verwendet werden) sind in der Tabelle 2 dargestellt.

Tabelle 2

Parameter	$F_{Los.}\times10^{-3}$	$W_{Los.}\times10^{-3}$	$W_{Ad.}\times10^{-2}$	$W_{Ko.}\times10^{-2}$	f
Konzentration 12 %					
Beton	1,8±0,1	4,5±0,3	21,3±0,4	42,5±0,4	-21,2±0,7
Stahl	2,1-0,3	5,2-0,5	24,6-0,2	49,0-0,4	-24,7-0,8
Konzentration 14 %					
Beton	2,1±0,2	5,3±0,5	26,5±0,5	52,9±0,9	-26,4±0,7

Parameter	$F_{Los.}\times10^{-3}$	$W_{Los.}\times10^{-3}$	$W_{Ad.}\times10^{-2}$	$W_{Ko.}\times10^{-2}$	f
Stahl	2,5- 0,3	6,3- 0,6	31,5- 0,1	62,8-0,8	-31,3 -0,4
Konzentration 16 %					
Beton	2,4±0,3	6,3±0,7	64,6±0,8	129,1±1,4	-64,5±1,1
Stahl	2,8-0,5	7,3- 0,5	74,8-0,5	149,3-1,4	-74,5- 1,2
Konzentration 100 %					
Beton	8±0,2	20±0,8	21,5±0,7	248,4±1,3	-226,9±1,3
Stahl	9,5-0,1	23-0,7	25,5-0,3	294,8-1,7	-269,4-1,4

Die Kraft der Loslösung.

$$F_{otp.} = ma \quad (1);$$

Die Adhäsionshaltbarkeit, J/m2.

$$W_{otp} = F_{otp} h \quad (2);$$

Die Arbeit der Adhäsion, J/m2.

$$W_{ad} = F_{otp} \frac{(1+\cos\Theta)}{b} \quad (3);$$

Die Arbeit der Kohäsion, J/m2.

$$W_{\hat{e}\hat{i}\,\tilde{a}.} = 2W_{\grave{a}\ddot{a}\tilde{a}.} / (1+\cos\Theta) \quad (4);$$

Der Spreizkoeffizient Tropfen J/m^2;

$$f = W_{ad.} - W_{ko.} \quad (5).$$

Das ataktische Polypropylen ist ein Nebenprodukt des sibirischen chemischen Kombinats. Das heißt, es sind Abfälle oder Atommüll.

Aber wenn es modifiziert wird, so wird sich das ataktische Polypropylen ins anwendungsreiche Material verwandeln.

Die Bearbeitung: zuerst muss es bis zu 150 C erwärmt werden und dann bis zu -30 C gekühlt werden und am Ende wird es noch einmal erwärmt.

Danach erwirbt das Material die einzigartigen Eigenschaften. Das sind Wasserdichte, die Temperaturbeständigkeit und der Vereisungschutz. Wenn eine Stromleitung mit ataktischem Polypropylen bearbeitet wird, kann das Problem der Vereisung für immer gelöst werden.

Es sind die Rechen- und Experimentaldaten der Parameter der Adhäsion angegeben, die eine der wichtigsten Charakteristiken sind, die die Qualität der Hydroisolation bestimmen. Es ist erwiesen, dass das abgeänderte ataktische Polypropylen im energetischen Zweig als Korrosionsschutzmaterial bei metallischen Konstruktionen und in der Stromisolation verwendet werden kann.

Das ataktische Polypropylen ist billig, weil es zu Abfällen gehört. Jedoch wenn das Material bearbeitet wird, so wird es über die einzigartigen Eigenschaften verfügen. Aber die Produktion des Polypropylens in den industriellen Maßstäben kostet viel Geld.

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Ветроэнергетика

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Ветроэнергетика – отрасль энергетики, специализирующаяся на преобразовании кинетической энергии воздушных масс в атмосфере в электрическую, механическую, тепловую или в любую другую форму энергии, удобную для использования в народном хозяйстве. Такое преобразование может осуществляться такими агрегатами, как ветрогенератор (для получения электрической энергии), ветряная мельница (для преобразования в механическую энергию), парус (для использования в транспорте) и другими.

Энергию ветра относят к возобновляемым видам энергии, так как она является следствием деятельности Солнца. Ветроэнергетика является бурно развивающейся отраслью, так в конце 2012 года общая установленная мощность всех ветрогенераторов составила 282,6 гигаватт[1]. В 2010 году количество электрической энергии, произведённой всеми ветрогенераторами мира, составило 430 тераватт-часов (2,5 % всей произведённой человечеством электрической энергии).[2][3] Некоторые страны особенно интенсивно развивают ветроэнергетику, в частности, на 2011 год в Дании с помощью ветрогенераторов производится 28 % всего электричества, в Португалии – 19 %, в Ирландии – 14 %,[4], в Испании – 16 % и в Германии – 8 %.[5] В мае 2009 года 80 стран мира использовали ветроэнергетику на коммерческой основе.[3].

Крупные ветряные электростанции включаются в общую сеть, более мелкие используются для снабжения электричеством удалённых районов. В отличие от ископаемого топлива, энергия ветра практически неисчерпаема, повсеместно доступна и более экологична. Однако, сооружение ветряных электростанций сопряжено с некоторыми трудностями технического и экономического характера, замедляющими распространение ветроэнергетики. В частности, непостоянство ветровых потоков не создаёт проблем при небольшой пропорции ветроэнергетики в общем производстве электроэнергии, однако при росте этой пропорции, возрастают также и проблемы надёжности производства электроэнергии.[6][7][8] Для решения подобных проблем используется интеллектуальное управление распределением электроэнергии.

Многие желающие установить экологичную энергосистему из-за недостатка информации сразу упираются в эту проблему. Какую систему лучше поставить? Солнечную? Ветряную? Обе сразу?.

Наиболее надежным источником энергии является солнечная панель. Потому что она гарантировано вырабатывает электричество каждый день. Распространен миф, что в пасмурную погоду солнечная панель не работает. Это не так. При рассеянном свете будет вырабатываться меньше энергии, но электричество все-таки будет. Причина, по которой солнечная энергетика еще не покорила мир, заключается в дороговизне изготовления солнечных панелей из-за сложного технологического процесса. Солнечная панель значительно компактнее ветряного генератора и не содержит движущихся частей, но при сопоставимой мощности обходится в несколько раз дороже.

Поэтому солнечные панели используют обычно в тех случаях, когда есть небольшое, но стабильное энергопотребление.[1] [3].

Ветрогенераторы в настоящее время являются лидерами при производстве больших объемов энергии и используются как для частных потребителей, так и в промышленных масштабах. Строго говоря, если бы ветряная энергетика получала столько же дотаций от государства, что и тепловая, гидро и атомная, то весь мир обеспечивался только энергией ветра. Но "обычных" электростанций уже построено много, а лобби компаний традиционных энергоносителей еще слишком сильно. Поэтому сейчас происходит постепенное, но уверенное усиление доли ветряной энергетики во всем мире. К сожалению пока в стороне от развития зеленой энергетики остается Россия. Повлиять на это можем только мы с вами, не дожидаясь, пока ослабнет атомное лобби в верхах. Никто не запрещает использование частных ветрогенераторов, а их разнообразие и качество на мировом рынке постоянно растет. Распространен миф о ненадежности ветряной энергетической системы. Дескать, нет ветра – нет энергии. Это не так. Во-первых, хоть в ветряной, хоть в солнечной системе вы используете энергию, запасенную в аккумуляторах и потребление не подсоединено к ветрогенератору или солнечной панели напрямую. А во-вторых, совсем безветренной погоды ни в каком географическом регионе длительное время не бывает. Если ветрогенератор установлен правильно и не закрыт от ветра рельефом, зданиями или стеной деревьев, то у вас всегда будет электричество. Надежность как промышленных так и частных ветроэнергетических установок уже давно сравнялась с традиционными источниками энергии. И у вас скорее закончится топливо в дизеле, чем у ветряка не хватит ветра.

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Элегазовые выключатели

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Общая информация

Элегазовый выключатель – это разновидность высоковольтного выключателя, коммутационный аппарат, использующий элегаз (шестифтористую серу, SF6) в качестве среды гашения электрической дуги.

Гашение дуги в элегазе происходит в бестоковую паузу и не вызывает перенапряжений. Это гарантирует длительную электрическую жизнь выключателя и ограничение количества динамических, диэлектрических и термических стрессов электроустановки в целом. Пружинный привод типа ESH с устройством свободного расцепления

позволяет производить надежное включение и отключение выключателя на месте установки и дистанционно. К положительным качествам выключателя ОНВ можно отнести компактность, стойкость к неблагоприятным воздействиям окружающей среды и механическую надежность.

Конструкция элегазового выключателя

По конструкции различают колонковые и баковые выключатели:

- **Колонковые** ни внешне, ни по размерам принципиально не отличаются от маломасляных.
- **Баковые** элегазовые выключатели имеют гораздо меньшие габариты по сравнению с масляными, имеют один общий привод на три полюса, встроенные трансформаторы тока.

Стандарты и тесты

Выключатели ОНВ соответствуют стандарту IEC 62271-100 – самой современной версии стандарта МЭК для высоковольтных выключателей. Они проходят все указанные ниже тесты и это гарантирует безопасность и надежность аппаратов в эксплуатации в составе любых электроустановок.

Типовые тесты:.

- температурный тест;
- диэлектрический тест;.
- тест на способность коммутирования тока короткое замыкание;
- временной тест на ток короткое замыкание;.
- механический тест.

Плановые тесты:

- 1 мин. напряжение промышленной частоты;.
- проверка изоляции вторичных цепей;.
- измерение сопротивления главной цепи;.
- механический и электрический операционный тест.

Преимущества и недостатки элегазовых выключателей

К преимуществам элегазовых выключателей можно отнести:

- гашение дуги происходит в замкнутом объеме без выхлопа в атмосферу;
- относительно малые габариты и масса;
- высокая отключающая способность;
- малый износ дугогасительных контактов;
- бесшумная работа;
- возможность создания серий с унифицированными узлами;
- пригодность для наружной и внутренней установки.

К недостаткам элегазовых выключателей можно отнести:

- сложность и дороговизна изготовления;
- температурные недостатки SF6;
- необходимость специальных устройств для наполнения, перекачки и очистки SF6;
- относительно высокая стоимость SF6.

Безопасность эксплуатации

Для обеспечения гарантий безопасной эксплуатации в выключателе ОНВ предусмотрены механическая и электрическая блокировки.

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Лампа накаливания

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Лампа накаливания – это электрический источник света, который излучает электромагнитные волны в широком спектральном диапазоне (включая видимый) благодаря телу накаливания, через которое протекает электрический ток. Тело накаливания помещено в сосуд с вакуумом или инертным газом. В качестве тела накаливания используют спираль из тугоплавкого металла вольфрама. Следует помнить, что первая запатентованная лампа накаливания была изобретена в 1838 году бельгийцем Жобар. Разряд в ней происходит в открытом воздухе между двумя угольными стержнями. Первую, похожую на современную, лампу накаливания запатентовал русский инженер Александр Николаевич Лодыгин 11 июня 1874 года. В 1890-х годах Лодыгин усовершенствовал свою лампу и презентовал несколько видов ламп с нитями накаливания из тугоплавкого металла. В лампе используется принцип термоэлектронной эмиссии. При прохождении электрического тока через тело накаливания электрического тока оно нагревается и начинает излучать электромагнитное тепловое излучение в соответствии с законом Планка. Лишь небольшую долю потребляемой энергии лампа преобразует в видимое излучение, большая часть рассеивается в виде тепла. Для повышения КПД лампы следует увеличить температуру накала нити. Самая большая температура плавления у Вольфрама – 3410 °С. Например, для получения света по спектру как у Солнца нужно разогреть нить до температуры 5771 К, что соответствует температуре фотосферы Солнца. Температура тела накаливания мала по сравнению с солнцем, поэтому свет излучаемый лампой по спектру ближе к красному. Энергия света связана с цветом. На рис. 1 показана эта связь.

Цвет	Длина волны, *нм*
Красный	760–620
Оранжевый	620–590
Желтый	590–575
Зеленый	575–510
Голубой	510–480
Синий	480–450

$$E = \frac{hc}{\lambda}.$$

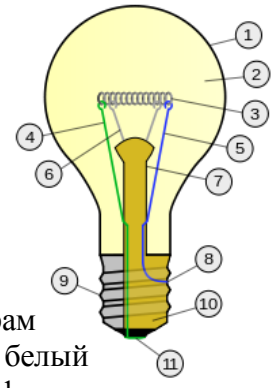

Рис. 1.Т.К.

В атмосферном воздухе при высоких температурах вольфрам быстро окисляется в триоксид вольфрама, образуя характерный белый налёт на внутренней поверхности лампы. По этой причине, вольфрамовое тело накала помещают в герметичную колбу с вакуумом или заполняют инертным газом – обычно аргоном. В колбах маломощных ламп (до 25 Вт) создают вакуум, а в мощных лампах заполняют инертным газом: аргон, азот или криптон [1]. Конструкция лампы

накаливания представляет собой: 1 – колба; 2 – полость колбы (с созданным в ней вакуумом или заполненная инертным газом); 3 – тело накала; 4,5 – электроды; 6 – крючки, которые держат тело накала; 7 – ножка лампы; 8 – предохранитель; 9 – цоколь; 10 – изолятор цоколя (стекло); 11 – контакт донышка цоколя. В обычных бытовых лампах предусматривается предохранитель – это звено из ферроникелевого сплава, вваренное в разрыв одного из токоотводов и расположенное вне колбы лампы – как правило, в ножке. Назначение предохранителя – предотвратить разрушение колбы при обрыве нити накала в процессе работы. Дело в том, что при этом в зоне разрыва возникает электрическая дуга, которая расплавляет остатки нити, капли расплавленного металла могут разрушить стекло колбы и послужить причиной пожара. Предохранитель рассчитан таким образом, чтобы при зажигании дуги он разрушался под воздействием тока дуги, существенно превышающего номинальный ток лампы. Ферроникелевое звено находится в полости, где давление равно атмосферному, а потому дуга легко гаснет [2]. Лампа накаливания имеет свои положительные стороны при использовании в промышленной и бытовой средах относительно других источников света. К преимуществам относятся:.

1) Спектр излучения привычный для глаз;
2) Устойчивость к электромагнитному импульсу;
3) Возможность регулирования яркости;
4) Стойкость к перепаду температур;
5) Налаженность в массовом производстве;
6) Низкая цена и простота устройства;
7) Небольшие размеры;

Следует отметить, что помимо преимуществ имеются некоторые недостатки. К последним относятся:

1) Небольшая световая отдача;
2) Небольшой срок службы;
3) Хрупкость колбы, чувствительность к ударам и вибрациям;
4) Малый КПД [3].

Резюмируя все вышесказанное, следует отметить, что лампа накаливания была долгое время востребована обществом, но учитывая современные потребности в экономии энергии, человечество выбрало люминесцентные лампы.

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Альтернативные источники энергии

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В современном мире, когда показатели потребления растут, а количество энергоресурсов ограничено, набирает обороты развитие технологий добычи энергии из альтернативных, возобновляемых источников. К таким источникам относятся, в первую очередь, солнечная и ветровая энергии, геотермальное тепло.

В настоящее время альтернативные источники энергии уже широко используются для решения проблем энергоснабжения, как в промышленных масштабах, так и в частном секторе. Доступность технологий получения энергии из неисчерпаемых источников позволяет строить энергонезависимые дома с экологически чистой инфраструктурой в удаленных районах и решать проблемы энергоснабжения уже существующих объектов.

Альтернативная энергетика – совокупность перспективных методик получения, передачи, а так же использования источников энергии, которые распространены не так широко, как классические, но представляют интерес выгодности их применения, как правило, из-за низкого риска причинения вреда окружающей среде.

В этой статье мы предлагаем вам рассмотреть краткое описание существующих источников альтернативной энергии, а так же их преимущества и недостатки.

Поиск и эксплуатация альтернативных (нетрадиционных) источников энергии является основным направлением альтернативной энергетики. Источники энергии – «встречающиеся в природе вещества и процессы, которые позволяют человеку извлечь необходимую для существования энергию» [1]. Альтернативный источник энергии является возобновляемым ресурсом, который заменяет традиционные источники энергии, использующие нефть, добываемый природный газ и угль, образующие при сгорании углекислый газ в атмосферу, который вызывает парниковый эффект и глобальное потепление. Основная причина поиска альтернативных источников энергии заключается в необходимости получать её из практически неисчерпаемых или возобновляемых природных ресурсов и явлений. При выборе альтернативных источников может браться во внимание их экологичность и экономичность. На данный момент существует три вида альтернативных источников энергии: солнечная, ветряная и геотермальная.

Излучением солнца можно воспользоваться как для получения электричества (с помощью фотоэлектрических элементов), так и для нужд теплоснабжения. Всевозможные гелиоустановки используют солнечное излучение в качестве альтернативного источника энергии. Эффективность преобразования энергии у солнечных батарей достигает 20% и зависит от чистоты кремния и технологии их производства. Технология стремительно развивается и показатель эффективности постоянно растет. Солнечные электростанции (СЭС) работают более чем в 80 странах. Возобновляемость, бесшумность, отсутствие вредных выбросов в атмосферу можно отнести к преимуществам данного источника энергии. Потребность в огромных площадях для строительства солнечных электростанций, а также, зависимость интенсивности солнечного излучения от сезонного и суточного ритма являются их недостатками. Использование ядовитых и токсичных веществ при изготовлении фотоэлектрических элементов (для гелиосистем) является экологической проблемой, что создаёт серьезную проблему их утилизации.

Ветер является одним из перспективнейших источников энергии. Принцип работы ветрогенератора прост: для того, чтобы привести в движение ветряное колесо используется сила ветра. В свою очередь это вращение передаётся ротору электрического генератора. В регионах, где средняя скорость ветра от 4.5 м/с и выше, строят ветря-

ные электростанции. В местностях, где часто бывает ветрено, ветер можно считать практически неисчерпаемым источником энергии. Производя энергию, ветрогенераторы не загрязняют атмосферу вредными выбросами. Недостатки этого типа энергии заключаются в непостоянстве силы ветра и небольшой мощности единичного ветрогенератора, так же они производят много шума, вследствие чего их стараются строить вдали от мест проживания людей.

С недавних пор многие страны расширяют использование ветроэнергетических установок. Чаще всего их используют в Индии, в США, Китае, в странах Западной Европы (Дания, ФРГ, Великобритания, Голландия). Сегодня Дания получает 25 % энергии из ветра.

В глубинах Земли хранится огромное количество тепловой энергии. Это обусловлено тем, что температура ядра Земли очень высока. В некоторых местах земного шара происходит непосредственный выход высокотемпературной магмы на поверхность Земли (вулканическая деятельность – горячие источники пара, воды). Сторонники геотермальной энергетики предлагают использовать эту энергию в качестве альтернативного источника. Геотермальные источники используют по –разному: одни источники служат для получения электричества из тепловой энергии, другие – для теплоснабжения. Стоит отметить, что этот вид энергии практически неисчерпаем и не зависит от времени суток и времени года. Термальные воды сильно минерализованы, и, часто, насыщены токсичными соединениями, что является недостатком. Это делает сброс геотермальных вод в поверхностные водоёмы невозможным. Отработанную воду необходимо закачивать в подземный водоносный горизонт. Некоторые учёные-сейсмологи выступают против данного вмешательства в глубокие слои Земли, утверждая, что это может спровоцировать землетрясения.

В странах Центральной Америки, на Филиппинах, в Исландии большую часть электроэнергии вырабатывают на геотермальных электростанциях. Исландия является страной, в которой термальные воды широко используются для отопления и обогрева.

Обобщая все выше изложенное, можно сделать следующий вывод:.

Эффективность использования тех или иных альтернативных источников энергии напрямую зависит от региона, в котором необходима установка. Качественный мониторинг энергопотенциала позволяет определять наиболее подходящую технологию и рассчитывать ее окупаемость на годы вперед, а так же исключает ошибки, связанные с региональными особенностями.

Поиски новых источников энергии считаются одним из важнейших требований времени. Ограниченные запасы естественного энергетического сырья: нефти, угля, газа, которые на данный момент являются основными видами топлива, требуют поиска других путей развития энергетики –эффективных источников энергии. Главными критериями в определении данных направлений развития энергетики обязаны стать безопасность и экологическая чистота. Постепенный переход на использование альтернативных источников энергии займет десятки лет. В данный период необходимо предпринимать меры по наиболее оптимальному использованию энергии, увеличению эффективности энергетических источников и энергосбережения в различных отраслях промышленности. В настоящий момент имеется ряд предложений по повышению эффективности аккумулирования и транспортировки энергии, которые связаны с использованием передовых энергосберегающих технологий.

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Синхронный двигатель

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В настоящее время важно понимать процесс электромеханического преобразования не только инженерам-электромеханикам, создающим электрические машины, но и многим другим специалистам, деятельность которых связана с электромеханикой. Одну из главных ролей играют электрические синхронные машины. Без них не может развиваться ни одна научная работа.

Синхронная машина – это электрическая машина переменного тока, частота вращения ротора которой равна частоте вращения магнитного поля в воздушном зазоре [2].

Роль постоянных магнитов в синхронных машинах очень велика. Основные функции, которые они выполняют: 1) значительное уменьшение внешних очертаний предметов 2) масса данного двигателя или машины (чем меньше вес машины, тем выгоднее работать с ней) 3) простое строение.

4) скорость работы машины должна увеличиваться 5) надежность устройства для применения в технической сфере [2,3].

В синхронных машинах постоянные магниты созданы для активного магнитного поля, постоянно находящегося в движении. В нем происходят важные процессы, не связанные с внешними условиями и силами. Очень важно, чтобы в процессе присутствовали только постоянные магниты, потому что от строения катушек зависит протекание постоянного тока. Используя комбинированное возбуждение, получить результат будет гораздо легче, так как есть возможность регулировать данные характеристики и величины в том направлении, которое нам нужно, при этом напряжение и частота вращения будут происходить при маленькой мощности, так как они не зависят от коэффициента напряжения [1].

Важным условием работы синхронной машины является переменный ток. Такие машины в основном используются в роли двигателя или генератора. Эти два элемента синхронная машина может легко заменить [3].

Применение синхронных двигателей происходит при передаче максимальной мощности, выходящей за рамки стандартов. Например, на заводах рабочие приводят в движение помпы и другие устройства, работа которых происходит с постоянной скоростью. На электрических станциях такой механизм не работает, поэтому приходится разрабатывать специальные машины или устройства, которые передают в сеть активную мощность, в которой нуждается синхронная машина [2].

Данное устройство относится к области применения трехфазных машин. Основная цель которой состоит в получении электроэнергии. Данная структура включает в себя трехфазовый синхронный двигатель и трехфазовый синхронный генератор. Статор двигателя, ротор и генератор имеют ярко проявленные полюса. Обмотки статора вертятся на этих полюсах. Постоянные магниты, которые находятся в движении, располагаются в спинках ротора. Полюса в этих спинках не соединены между собой, поэтому пространство, которое остается между ними, занимают постоянные магниты [1,2,3].

Полюса ротора имеют центр, в котором тесно фигурируют компенсационные постоянные магниты, отличающиеся по своему строению. Постоянные магниты имеют плоское строение, легко проводят электрический ток, который необходим для эффективной работы [1].

Принцип синхронной машины при ее работе основан на связи и согласовании при этом магнитных полей статора и ротора. Согласно схеме (рис.1), магнитное поле статора изображается полюсами магнитов, движущихся в пространстве. Движение обусловлено вращением, скорость которого зависит от скорости магнитного поля статора. Поле ротора аналогично можно изобразить в том же виде. Условие единственное – постоянный магнит, вращающийся с полем статора [3].

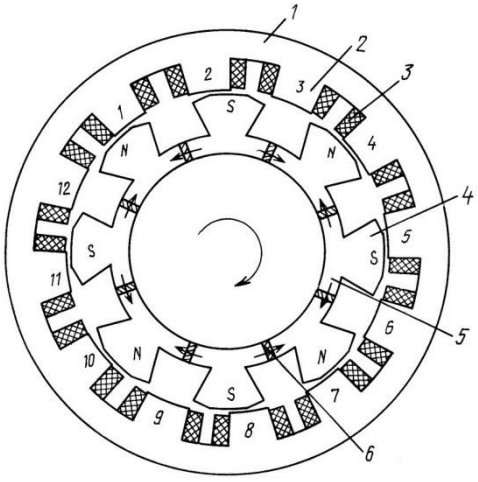

Рис.1.
1 – спинка статора.
2 – полюс статора.
3 – обмотка статора.
4 – полюс ротора.
5 – спинка ротора.
6 – возбужденные магниты.

Основным элементом синхронного двигателя является синхронный компенсатор.

Синхронный компенсатор – изобретение, связанное с применением синхронных машин трехфазного типа, строение их своеобразно и имеет особенность – возбуждение от постоянных магнитов. На данный момент эта тема является открытой для дискуссий, так как многие исследователи не пришли к единому выводу по данной проблеме [1].

Основным недостатком синхронных машин является поток вектора магнитной индукции, который создается постоянными магнитами, эти магниты располагаются в полюсах ротора, пересекающих проводник обмотки статора. Происходит закономерность, не свойственная при обычном режиме. Гальваническая мощность в генераторе равна механической мощности, которая требуется генератору. Потери энергии при этом не учитываются как в статоре, так и в роторе. Такой же процесс происходит в двигателе. Эффективность, которая изложена при работе синхронных машин, всегда меньше единицы [1,2,3].

Оси полей ротора и статора будут соединяться в единой точке тогда, когда вращающий момент будет их общим центром [3].

К ротору может прикладываться внешний момент, который создает ускорение, то есть скорость становится гораздо больше скорости приложенного момента или полностью отсутствует [2].

Синхронные двигатели имеют широкое использование. Без них современная техника не может развиваться быстрыми темпами. Синхронная машина, прежде

всего, разрушает нормы технической деятельности. Она имеет постоянную скорость, что очень выгодно для современной работы. Скорость вращения и показатель мощности колеблются в огромных диапазонах. Они могут работать на полную мощность или частично, в зависимости от того, что требуется. Синхронные двигатели отличаются от генераторов наличием на роторе короткозамкнутой обмотки, которая позволяет сократить воздушные зазоры между статором и ротором. У синхронных двигателей уровень эффективности полезного действия очень высокий, а масса на единицу меньше мощности [2,3].

Синхронный двигатель является универсальным средством для выполнения различных функций, которые на данный момент являются первой необходимостью. Его значение в технике очень велико, так как развитие этой машины достигло максимального уровня, при котором выполняется работа, необходимая современному инженеру для достижения высоких результатов.

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Релейная защита

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Ни один элемент электроэнергетической системы (генератор, трансформатор, линия электропередачи, сборные шины и др.) не обладает абсолютной надежностью. С большей или меньшей вероятностью он может быть поврежден, причем большинство повреждений сопровождается возникновением короткого замыкания. Режим короткого замыкания опасен для энергосистемы: устойчивая работа энергосистемы может быть нарушена, из-за существенного искажения параметров режима энергосистемы потребители электроэнергии теряют электропитание, длительное существование токов короткого замыкания разрушает повредившийся элемент энергосистемы до неремонтопригодного состояния.

Назначением релейной защиты является выявление поврежденного элемента и быстрейшее его отключение от энергосистемы. Кроме того, устройства релейной защиты должны предупреждать повреждение элемента энергосистемы в случае возникновения ненормального и опасного для него режима работы такие как перегрузка или неполно фазный режим и так далее.

Основные требования, предъявляемые к устройствам релейной защиты:

1. Селективность – способность устройства релейной защиты выявить и отключить поврежденный элемент энергосистемы.
2. Быстродействие – способность релейной защиты в кратчайший промежуток времени выявить и отключить поврежденный элемент энергосистемы.
3. Чувствительность – способность устройства релейной защиты четко отличать режим короткого замыкания любого вида (трехфазное, двухфазное, однофазное короткое замыкание) от всевозможных, даже утяжеленных режимов работы защищаемого объекта при отсутствии короткого замыкания.

4. Надежность – отсутствие отказов или ложных срабатываний релейной защиты, что обеспечивается как функциональной, так и аппаратной надежностью устройства защиты.

Устройства релейной защиты реагируют, естественно, на значения параметров режима защищаемого объекта (ток, напряжение, направление мощности и др.). По способу обеспечения селективности устройства релейной защиты подразделяются на две группы: с относительной селективностью и с абсолютной селективностью. Селективность защит первой группы обеспечивается выбором значений параметров срабатывания защиты, а селективность защит второй группы обеспечивается принципом их действия, т.е. защиты с абсолютной селективностью по принципу своего действия не реагируют на внешние по отношению к защищаемому объекту короткого замыкания. К защитам с относительной селективностью относятся в основном токовые и дистанционные защиты, а к защитам с абсолютной селективностью продольные и поперечные дифференциальные защиты, направленные защиты с высокочастотной блокировкой, дифференциально-фазные защиты, а также защиты, реагирующие на неэлектрические параметры (газовая защита трансформатора, дуговая защита шин и др.).

Любое устройство релейной защиты содержит, как правило, три составные части: измерительную, логическую и исполнительную. В состав измерительной части может входить один или несколько пусковых органов. Назначением измерительной части защиты является сравнение текущих значений параметров режима защищаемого объекта с заданными значениями, при которых защита должна срабатывать, т.е. с установкой. В зависимости от вида РЗ такими параметрами могут быть ток, напряжение, направление мощности, отношение напряжения к току, т.е. сопротивление, и др. Если защита должна срабатывать при значениях параметра режима бóльших уставки, она называется максимальной, а если при значениях параметра меньших уставки – минимальной. Для обеспечения нормальной работы энергетической системы и потребителей электроэнергии необходимо возможно быстрее выявлять и отделять место повреждения от неповрежденной сети, восстанавливая таким путем нормальные условия работы энергосистемы и потребителей.

Опасные последствия ненормальных режимов также можно предотвратить, если своевременно обнаружить отклонение от нормального режима и принять меры к его устранению (например; снизить ток при его возрастании, повысить напряжение при его снижении и т. д.).

В связи с этим и возникает необходимость в создании и применении автоматических устройств, выполняющих указанные операции и защищающих систему и ее элементы от опасных последствий повреждений и ненормальных режимов.

Первоначально в качестве защитных устройств применялись плавкие предохранители. Однако по мере роста мощности и напряжения электрических установок и усложнения их схем коммутации такой способ защиты стал недостаточным, в силу чего были созданы защитные устройства, выполняемые при помощи специальных автоматов – реле, получившие название релейной защиты. Релейная защита является основным видом электрической автоматики, без которой невозможна нормальная и надежная работа современных энергетических систем. Она осуществляет непрерывный контроль за состоянием и режимом работы всех элементов энергосистемы и реагирует на возникновение повреждений и ненормальных режимов.

При возникновении повреждений защита выявляет и отключает от системы поврежденный участок, воздействуя на специальные силовые выключатели, предназначенные для размыкания токов повреждения.

При возникновении ненормальных режимов защита выявляет их и в зависимости от характера нарушения производит операции, необходимые для восстановления нормального режима, или подает сигнал дежурному персоналу. В современных электрических системах релейная защита тесно связана с электрической автоматикой, предназначенной для быстрого автоматического восстановления нормального режима и питания потребителей.

К основным устройствам такой автоматики относятся: автоматы повторного включения (АПВ), автоматы включения резервных источников питания и оборудования (АВР) и автоматы частотной разгрузки (АЧР).

Рассмотрим более подробно основные виды повреждений и ненормальных режимов, возникающих в электрических установках, и их последствия.

Большинство повреждений в электрических системах приводит к коротким замыканиям фаз между собой или на землю. В обмотках электрических машин и трансформаторов, кроме того, бывают замыкания между витками одной фазы.

Основными причинами повреждений являются: нарушения изоляции, вызванные старением ее, неудовлетворительным состоянием, перенапряжениями и механическими повреждениями (обрыв проводов, наброс на провода и др.), и ошибки персонала при операциях (отключение разъединителей под нагрузкой, включение под напряжение на оставленную закоротку и т. п.).

Все повреждения являются следствием конструктивных недостатков или несовершенства оборудования, некачественного его изготовления, дефектов монтажа, ошибок при проектировании, неудовлетворительного или неправильного ухода за оборудованием, ненормальных режимов работы оборудования. Поэтому повреждения нельзя считать неизбежными, но в то же время нельзя и не учитывать возможность их возникновения.

Короткие замыкания подразделяются на трехфазные, двухфазные и однофазные в зависимости от числа замкнувшихся фаз; замыкания с землей и без земли; замыкания в одной и двух точках сети. При (КЗ) вследствие увеличения тока возрастает падение напряжения в элементах системы, что приводит к понижению напряжения во всех, точках сети. Наибольшее снижение напряжения происходит в месте (КЗ) и в непосредственной близости от него. В точках сети, удаленных от места повреждения, напряжение снижается в меньшей степени. В месте повреждения это тепло и пламя электрической дуги производят большие разрушения, размеры которого тем больше, чем больше ток (КЗ) и время. Проходя по неповрежденному оборудованию и линиям электропередачи, ток (КЗ) нагревает их выше допустимого предела, что может вызвать повреждение изоляции и токоведущих частей. Основным потребителем электроэнергии являются асинхронные электродвигатели. Момент вращения двигателей пропорционален квадрату напряжения на их зажимах. Поэтому при глубоком снижении напряжения момент вращения электродвигателей может оказаться меньше момента сопротивления механизмов, что приводит к их остановке. Нормальная работа осветительных установок, составляющих вторую значительную часть потребителей электроэнергии, при снижении напряжения также нарушается. Особенно чувствительны к понижениям напряжения вычислительные и управляющие электронные машины, широко внедряемые в последнее время.

Вторым, наиболее тяжелым последствием снижения напряжения является нарушение устойчивости параллельной работы генераторов. Это может привести к распаду системы и прекращению питания всех ее потребителей.

Так же существует ненормальные режимы работы тока. К ненормальным относят-

ся режимы, связанные с отклонениями от допустимых значений величин тока, напряжения и частоты, опасные для оборудования или устойчивой работы энергосистемы. Рассмотрим наиболее характерные ненормальные режимы. Перегрузка оборудования, вызванная увеличением тока сверх номинального значения. Номинальным называется максимальный ток, допускаемый для данного оборудования в течение неограниченного времени. Если ток, проходящий по оборудованию, превышает номинальное значение, то за счет выделяемого им дополнительного тепла температура токоведущих частей и изоляции через некоторое время превосходит допустимую величину, что приводит к ускоренному износу изоляции и ее повреждению. Время, допустимое для прохождения повышенных токов, зависит от их величины. Для предупреждения повреждения оборудования при его перегрузке необходимо принять меры к разгрузке или отключению оборудования.

Снижение частоты, вызываемое недостатком генераторной мощности, обычно возникает при внезапном отключении части работающих генераторов. При снижении частоты понижается производительность механизмов и нарушается технологический процесс тех агрегатов, для которых имеет значение постоянство скорости вращения электродвигателей.

Повышение напряжения сверх допустимого значения возникает обычно на гидрогенераторах при внезапном отключении их нагрузки. Разгрузившийся гидрогенератор увеличивает скорость вращения, что вызывает возрастание Э. Д. С. статора до опасных для его изоляции значений. Защита в таких случаях должна снизить ток возбуждения генератора или отключить его.

Опасное для изоляции оборудования повышение напряжения может возникнуть также при одностороннем отключении или включении длинных линий электропередачи с большой емкостной проводимостью. Кроме отмеченных ненормальных режимов, имеются и другие, ликвидация которых возможна при помощи релейной защиты.

Обычно устройства релейной защиты состоят из нескольких реле, соединенных друг с другом по определенной схеме. Реле представляет собой автоматическое устройство, которое приходит в действие (срабатывает) при определенном значении воздействующей на него входной величины. В релейной технике применяются реле с контактами – электромеханические, и бесконтактные – на полупроводниках или на ферромагнитных элементах. У первых при срабатывании замыкаются или размыкаются контакты. У вторых – при определенном значении входной величины скачкообразно меняется выходная величина, например напряжение.

Каждое устройство защиты и его схема подразделяются на две части: реагирующую и логическую. Реагирующая (или измерительная) часть является главной, она состоит из основных реле, которые непрерывно получают информацию о состоянии защищаемого элемента и реагируют на повреждения или ненормальные режимы, подавая соответствующие команды на логическую часть защиты. Логическая часть (или оперативная) является вспомогательной, она воспринимает команды реагирующей части и, если их последовательность и сочетание соответствуют заданной программе, производит заранее предусмотренные операции и подает управляющий импульс на отключение выключателей. Логическая часть может выполняться с помощью электромеханических реле или схем с использованием электронных приборов – ламповых или полупроводниковых.

В соответствии с этим подразделением защитных устройств реле так же делятся на две группы: на основные, реагирующие на повреждения, и вспомогательные, дей-

ствующие по команде первых и используемые в логической части схемы. Признаком появления (КЗ) могут служить возрастание тока I, понижение напряжения U и уменьшение сопротивления защищаемого участка, характеризуемого отношением напряжения к току в данной точке сети, Z = U/I.

Соответственно этому в качестве реагирующих реле применяют реле токовые, реагирующие на величину тока, реле напряжения, реагирующие на величину напряжения, и реле сопротивления, реагирующие на изменение сопротивления. В сочетании с указанными реле часто применяются реле мощности, реагирующие на величину и направление (знак) мощности (КЗ), проходящей через место установки защиты. Реле, действующие при возрастании величины, на которую они реагируют, называются максимальными, а реле, работающие при снижении этой величины, называются минимальными. Для защит от ненормальных режимов, так же как и для защит от (КЗ), используются реле тока и напряжения. Первые служат в качестве реле, реагирующих на перегрузку, а вторые – на опасное повышение или снижение напряжения в сети. Кроме того, применяется ряд специальных реле, например, реле частоты, действующие при недопустимом снижении или повышении частоты; тепловые реле, реагирующие на увеличение тепла, выделяемого током при перегрузках, и некоторые другие. К числу вспомогательных реле относятся: реле времени, служащие для замедления действия защиты; реле указательные – для сигнализации и фиксации действия защиты; реле промежуточные, передающие действие основных реле на отключение выключателей и служащие для осуществления взаимной связи, между, элементами защиты.

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Газопоршневые электростанции

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Развитие энергетики в наши дни является одной из самых главных задач, ведь запасы нефти и газа могут истощиться в ближайшие десятилетия. С каждым годом в мире появляется все больше и больше новых устройств для получения электроэнергии. Эта статья посвящена одному из таких устройств – Газопоршневая электростанция.

Газопоршневая электростанция – это система генерации, созданная на основе поршневого двигателя внутреннего сгорания, работающего на природном или другом горючем газе[3]. Данная установка не используется для обеспечения энергией городов, она предназначена для частных предприятий, загородных домов и других потребителей электроэнергии, которые хотят снизить затраты по платежам и приобрести независимость от централизованных сетей энергоснабжения.

Газопоршневые электростанции вырабатывают не только электроэнергию, также они вырабатывают тепло и холод. Возможно получение двух видов энергии: тепло и

электричество(этот процесс называется – когенерация). Также можно получать три вида энергии: тепло, электричество и холод(такой процесс называется – тригенерация). Электростанции которые вырабатывают три вида энергии актуальны на предприятиях которые зависят от вентиляции и промышленного охлаждения складов.

Принцип действия такой установки достаточно прост. ГПЭ(газопоршневая электростанция) представляет собой двигатель внутреннего сгорания с внешним смесеобразованием и искровым зажиганием горючей смеси в камере сгорания, использующий в качестве топлива газ и работающий по циклу Отто. Энергия, выделившаяся при сгорании топлива, в газовом двигателе производит механическую работу на валу, которая используется для выработки электроэнергии генератором электрического тока. Газовые двигатели используются для работы в составе генераторных установок, предназначенных для постоянной и периодической работы (пиковые нагрузки) с комбинированной выработкой электроэнергии и тепла, а также в качестве аварийных источников энергии. Кроме того, они могут работать как в составе холодильных установок, так и для привода насосов и газовых компрессоров[1]. Сама конструкция двигателя, работающего на газовом топливе, не подвержена сильному износу за счет отсутствия в газе частиц, которые могут повредить его изнутри. Отличительной особенностью качественных газопоршневых установок являются низкие обороты двигателей – 750 в минуту. На более мощных агрегатах количество оборотов составляет 120 – 130 в минуту! Такие низкие обороты снижают износ оборудования и значительно повышают ресурс газопоршневых агрегатов – гарантированный срок службы составляет 300000 часов –35-40 лет непрерывной работы. Первый капитальный ремонт понадобится только через 12 лет.

Преимущества: 1.Себестоимость электроэнергии, вырабатываемой газопоршневыми электростанциями, в несколько раз ниже тарифов, предлагаемых централизованными сетями.

2.Расход газа для получения 1 кВт электричества составляет всего 0.23-0.29 м3, при этом дополнительно вырабатывается бесплатная тепловая энергия (до 4,5 кВт).

3.Средний срок возврата инвестиций в газопоршневую электростанцию составляет всего 3-5 лет. Учитывая повышающиеся тарифы на электроэнергию и высокую стоимость подключения к централизованным сетям, этот срок может быть даже сокращен[2].

Работают такие станции на различных видах газа: природный, газы с низкой теплотворной способностью, невысоким содержанием метана и низкой степенью детонации или газы с высокой теплотворной способностью- факельный, пропан, бутан а также они приспособлены к перестройке для работы с одного вида газа на другой. Также, есть возможность применения двутопливных двигателей, работающих одновременно на жидком и газообразном видах топлива.

Одним из недостатков таких установок, является высокая концентрация вредных веществ в выхлопах,что требует применение весьма дорогостоящих катализаторов. Вредные вещества в выхлопе появляются из-за сгорания моторного масла. Для снижения вредного воздействия на окружающую среду электростанциям требуются высокие дымовые трубы.

Газопоршневые установки отличаются высокой удельной мощностью при низком расходе топлива, поэтому их строительство является экономически целесообразным для многих предприятий и объектов ЖКХ. Строительство электростанций проводится для получения энергетической независимости и увеличения мощности энергоснабже-

ния предприятия. Для снижения затрат очень удобна реконструкция существующих котельных и их перевод на базе когенерационных установок в режим мини-ТЭС.

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Перспективы развития электроэнергетики

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Энергетика лежит в основе развития производственных сил любого государства и обеспечивает бесперебойную работу промышленности, транспорта, народного хозяйства. Стабильность развития национальной экономики невозможна без постоянно развивающей энергетики [5]. По оценкам экспертов, к 2050 г. потребление энергии удвоится, что, в свою очередь, приведет к удвоению содержания CO_2 в атмосфере и усилению парникового эффекта. В настоящее время исследование и разработки по альтернативной энергетике является одним из приоритетных направлением развития научно-технического комплекса России на 2014-2020 годы. Это программа поддерживается различными Федеральными целевыми программами Министерством образования и науки РФ.

Одним из способов получения энергии является возобновляемые источники. Одной из причин развития этого направления является истощение запасов углеводорода на планете, ученые и практики считают, что уже сейчас необходимо начинать переход на иные виды топлива.

Возобновляемые источники энергии подразделяют на две подгруппы: традиционные, к которым в первую очередь относят гидроэнергетику и частично энергию биомассы, и нетрадиционные, также называемые альтернативными, куда входит ветроэнергетика, солнечная и прочие источники, широкое использование которых началось сравнительно недавно. Альтернативная энергетика становится все более популярной и в последние годы появляются новые прорывные технологии в этой области. Это в свою очередь ведет на удешевление вырабатываемой энергии. Сегодня на долю альтернативной электроэнергетики приходится всего 2% (534 млрд. кВт.ч) от мирового производства электроэнергии. Из них на биомассовою энергетику и утилизацию мусора приходится 47% (253 млрд. кВТ.ч); на ветряную энергетику – 39% (210 млрд. кВт.ч); на геотермальную энергетику – 11% (60 млрд. кВт.ч); на солнечную и приливную энергетику – порядка 2% (11 млрд. кВт.ч) [7].

Биотопливо является одним из самых распространенных возобновляемых источников энергии, используемых в мире в настоящее время, который имеет высокий технический потенциал для будущего глобального энергоснабжения. Основными потребителями биотоплива являются низкоэффективные энергетические системы пище-

приготовления и отопления, а также транспортные энергетические установки, потребляющие жидкое биотопливо.

XXI век характеризуется активным внедрением во все сферы жизнедеятельности альтернативных видов энергии, в том числе биоэнергетики, которая приобретает все большую социальную востребованность и в настоящее время входит в число основных приоритетов инновационного развития экономики. Биоэнергетика это направление, возникшее на границе современных биотехнологий, химической технологии и энергетики, изучающее и разрабатывающее пути биологической конверсии солнечной энергии в топливо и биомассу и биологическую и термохимическую трансформацию последней в топливо и энергию [3]. Существенное место в биоэнергетике занимает биомасса, как постоянно возобновляемый источник биотоплива.

Биомассе относят все виды веществ растительного и животного происхождения, продукты жизнедеятельности организмов и органические отходы, образующиеся в процессах производства, потребления продукции и на этапах технологического цикла отходов.

Объемы использования биомассы в мире в настоящее время точно неизвестны, так как это учитываются только в больших хозяйствах. Использование биомассы для производства энергии экспертами оценивается примерно в 10 % глобального потребления энергии всех видов, или около 1070±240 млн. т нефтяного эквивалента в год [6]. Основу сырьевой базы для биоэнергетики в России составляют органическая биомасса растительного и животного происхождения и различные виды отходов, пригодные для переработки.

По прогнозу МЭА, использование биотоплива в мире к 2050 году увеличится почти в 4 раза и может составить 23% общего потребления первичной энергии, или 3604 млн тонн нефтяного эквивалента в год, для чего необходимо производство 15,0 млрд тонн биомассы. Примерно половина этого объёма будет обеспечиваться естественным приростом биомассы с полей и лесов, а другая половина потребует ее искусственного воспроизводства на соответствующих плантациях, площадь которых может составить примерно 50% всех земельных площадей Африки [4].

Следует отметить потенциальные запасы энергетической биомассы в России, достаточные для создания электростанций мощностью не менее 5 МВт [1]. В России электростанции мощностью 5 МВт можно создавать при использовании древесины, торфа и куриного помета при их сжигании. Наряду с ними, большой интерес представляет использование в качестве источника энергии твердых бытовых отходов (ТБО), образующихся в результате жизнедеятельности населения. Объемы накопления ТБО в современном городе составляют от 250 до 700 кг/чел. в год. В развитых странах эта величина ежегодно возрастает на 4-6%, что превышает темпы прироста населения. Мощность электростанции работающей на твердых бытовых отходах составляет около 60 тыс. МВт электроэнергии и 225 тыс. Гкал тепла в год. Мощность переработки ТБО – 180 тыс. т в год [2].

В России в 2006 г. общее поголовье крупного рогатого скота по всем категориям хозяйств составляло 23.9 млн. голов, свиней – 17 млн. голов, что в год дает до 240 млн. т навоза. Их полная переработка в биогаз позволит получить до 9.6 млрд. куб. м или 19.2 млрд кВт-час при к.п.д.33% [1]. При использовании когенерационных установок выход электроэнергии будет выше и одновременно до 45% биогаза трансформируется в тепловую энергию.

Для крупных хозяйств, которых насчитывается до 18.7 тысяч голов и имеющих до 114 млн. т/год выход биогаза составит 4.6 млрд. куб. м, и электроэнергии, соответ-

ственно, 9.2. млрд. кВт/год. Общая мощность электростанций составит более 1 тыс. мВт или 200 пятимеговатных станций.

Особенность биоэнергетики в отличие от других видов *возобновляемых источников энергии* состоит в том, она позволяет получать энергию из различных видов биомассы. В первую очередь, из многочисленных органических отходов растительного и животного происхождения наряду с топливом и энергией получать высокоэффективные органические вещества микробного происхождения. Полученную продукцию можно использовать в разных отраслях сельскохозяйственного производства: в растениеводстве – удобрения, в животноводстве и в птицеводстве – кормовые дрожжи, кормовой препарат витамина В-12, белково-витаминные кормовые препараты, ступенчато выделяемые из метано-генного консорциума [3].

Таким образом, развитие биоэнергетики может стать одним из способов решения энергетических проблем значительной части территории РФ. С одной стороны может сыграть главную роль в обеспечении замены традиционного моторного биотоплива на экологически безопасное, изготавливаемое на основе возобновляемого сырья, а с другой позволить сократить выбросы двуокиси углерода, способствовать обеспечению устойчивого развития энергетики и экономики в целом.

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Генератор переменного тока

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В настоящее время генератор переменного тока имеет важное значение не только в технической сфере, но и в повседневной жизни каждого человека. На данный момент эта тема является актуальной среди ученых и физиков, постоянно обсуждаются вопросы, которые в дальнейшем помогают прийти к единому выводу. В работе рассматривается демонстрационная модель "Генератора переменного тока" используемая как в традиционном, так и в углубленном курсе физики при изучении темы "Электромагнитная индукция". В проведенном нами исследовании было уделено осо-

бое внимание принципу работы генератора переменного тока. Основная задача исследования − рассмотреть пользу генератора переменного тока и его применение.

Генератор переменного тока служит для преобразования механической энергии в электрическую, необходимую для питания всех приборов электрооборудования автомобиля, кроме стартера, и для заряда аккумуляторной батареи. В настоящее время на автомобилях широко используются генераторы переменного тока, которые являются преимуществом для их конструкции над генераторами постоянного тока. К этим преимуществам мы можем отнести следующие факторы: меньшая масса, длительный срок службы, меньшее количество меди, требуемое для изготовления обмотки (в 2-2,5 раза), повышение передаточного числа от двигателя к генератору до 2,5-3,0. Увеличение передаточного числа от двигателя к генератору способствует отдача мощности от генератора к аккумуляторной батарее на автомобиле, что улучшает эффективность ее заряда, и следовательно, более длительный срок службы [1].

Принцип работы генератора переменного тока − это преобразование механической (кинетической) энергии в электроэнергию. В энергетике используются только вращающиеся электромашинные генераторы, основанные на электродвижущей силе (ЭДС) в проводнике, которая действует на изменяющееся магнитное поле. Индуктором называется часть генератора, предназначенная для создания магнитного тока, а часть, в которой индуцируется ЭДС − якорем. Вращающаяся часть машины называется ротором, а неподвижная часть – статором. Роль индуктора в машинах постоянного тока выполняет статор, а в синхронных машинах переменного тока − ротор. В этих случаях индуктор представляет собой двух-или многополюсную электромагнитную систему, снабженную обмоткой возбуждения, питаемой постоянным током (током возбуждения), но существуют и индукторы, состоящие из системы постоянных магнитов. В настоящее время в асинхронных (индукционных) генераторах переменного тока якорь и индуктор почти не отличаются друг от друга. Таким образом, можно предположить, что статор и ротор являются и якорем, и индуктором [2].

На данный момент 95% электроэнергии производится с помощью синхронных генераторов переменного тока. Магнитное поле, наводящее в статорной трехфазной обмотке переменную ЭДС, с частотой, соответствующей частоте вращения ротора, создается при вращении индуктора. При этом ротор находится в синхронной частоте вращения индуктора, если в индукторе имеется два полюса, а частота вращения − 3000 r/min (50 r/s), то переменная ЭДС статорной обмотки индуцируется с частотой 50Hz.

Генераторы тока различаются по напряжению на его выходе, а также по нелинейной зависимости от внешних условий. К ним мы можем отнести реальные генераторы, создающие электрический ток в некотором диапазоне напряжения. В этом случае напряжение питания источника будет зависеть от верхнего порога.

Источники тока нашли широкое применение в аналоговой самотехнике. Например: питание электричеством измерительных мостов, каскадов дифференциальных усилителей. К электромеханическим источникам тока относятся: 1) источник тока, управляемый напряжением (ИТУН), 2) источник тока, управляемый током (ИТУТ) [3].

Особая необходимость в генераторах переменного тока возникла в 1876 году, когда работающий в то время в Париже русский электротехник Павел Яблочков разработал дуговые лампы, которые использовались для освещения городских улиц. Эти лампы переменного тока впоследствии назвали "Свечами Яблочкова". Зеноб Теофиль Грам создал первые генераторы, предназначенные для обеспечения электричеством лампочек переменного тока. В 1879 году переменный ток потерял свое значение, в

связи с массовым производством ламп накаливания, но вновь обрел актуальность в середине 1880 года. В 1888 –1890 годах сербский электротехник Никола Тесла и русский электротехник Михаил Доливо-Добровольский разработали трехфазную систему переменного тока. В результате создания трехфазной системы переменного тока началось производство все более мощных синхронных генераторов переменного тока, которые впоследствии были использованы в промышленности, на тепло- и гидроэлектростанциях.

Одним из главных этапов в развитии турбогенераторов может считаться разработка в 1898 году цилиндрического ротора Чарлзом Эженом Ланселотом Брауном. Первый генератор, основанный на водородном охлаждении (мощностью 25 MW), был создан в 1937 году американской фирмой Дженерал Электрик, а с внутрипроводным водяным охлаждением – в 1956 году английской фирмой Метрополитен Виккерс[4].

Современный генератор переменного тока – это внушительное сооружение из медных проводов и вставок, изоляционных материалов и стальных конструкций. Детали, которые в габаритах достигают несколько метров, изготавливаются в точности до миллиметров. В природе не встречается такое сочетание движущихся частей, которые могли бы порождать электрическую энергию столь же непрерывно и экономично.

В настоящее время потребление энергии и ее производство играет важную роль. Главная задача энергетики стоит в получении энергии в форме потребления. В процессе потребления энергия переходит во внутреннюю энергию (теплоту). Это является одним из важнейших показателей развития производственных сил общества.

Основную роль в обществе играет электричество – это самая универсальная и удобная форма энергии. Если за 25 лет потребление электричества в среднем увеличится в 2 раза, то потребление электрической энергии увеличится в 2 раза в среднем за 10 лет. Этот факт означат, что человек все больше и больше использует процессы, связанные с потреблением энергоресурсов в форме электричества.

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Исследование влияния сотовых телефонов на организм человека

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Вреден ли телефон для нашего здоровья? Существует множество исследований, выдвигаются и опровергаются различные предположения. Пользователей сотовой связи волнует этот вопрос, однако сколько-нибудь вразумительного ответа на него пока не дал никто: ни учёные, ни официальная медицина, ни производители сотовых телефонов. Одни специалисты говорят, что сотовый телефон опасен не более, чем любые бытовые приборы, а другие считают его одной из причин многих серьёзных заболеваний [1]. За последние 7-8 лет мобильный телефон стал неотъемлемой частью нашей жизни. Сегодня нам уже трудно представить, как это мы раньше обходились без такой нужной, удобной, просто необходимой вещи. Большинство людей, случай-

но выйдя на улицу без мобильника, чувствуют себя как «без рук», или без важной детали одежды – в общем, некомфортно и неуютно. Некоторые представители официальной медицины, а также ведущие учёные считают, что телефоны опасны не только для взрослых, но особенно для детей, и вообще представляют угрозу для здоровья всего человечества. Ведь большинство людей разговаривают по мобильному по нескольку часов в сутки, причём в любое время суток [2]. Наш мозг поглощает значительную часть электромагнитной энергии, которую излучает телефон для того, чтобы связаться с базовой станцией связи, как следствие, у людей, которые постоянно пользуются мобильными телефонами могут развиться ряд заболеваний: болезнь Альцгеймера, различные опухоли мозга, депрессии различной степени тяжести, приобретённое слабоумие, шизофрения и другие разрушительные процессы в структуре головного мозга. Особенно вероятным становится развитие этих заболеваний у детей, которые пользуются телефоном в раннем возрасте, от 5 до 10 лет. Не так давно учёные Евросоюза провели очень серьёзное исследование, результаты которого показали, что при определённом уровне электромагнитного излучения возможны повреждения в структуре ДНК. Для определения вредности воздействия телефона, существуют стандарты, определяющие воздействие на человека радиочастот, излучаемых мобильными телефонами и используют такое понятие, как SAR (Specific Absorbtion Rate) – единицу измерения удельной величины поглощения излучения организмом человека [3]. В качестве эксперимента, я исследовал модели телефонов, используемых студентами первого курса.

Данные приведены в таблице:

Модели телефонов	SAR (Specific Absorbtion Rate)
Apple iPhone 5	0.95
Apple iPhone 4S	0.99
Apple iPhone 4	0.74
Samsung GT-I9100 Galaxy S II S2	0.35
Samsung GT-I9300 Galaxy S III S3	0.34
Samsung GT-N7000 Galaxy Note	0.26
Samsung GT-i8160 Galaxy Ace 2	0.50
HTC T9292 HD7 HD3	0.66
HTC Touch Diamond2	0.78
HTC T8585 HD2 Leo	0.63
Asus P835	0.34
Sony CMD-X2000	0.70
Nokia 900 Lumia RM-808	1.24
Nokia 900 Lumia RM-823	1.33
Nokia 306 Asha RM-768	0.71
Motorola RAZR V3	0.89
LG P990 Optimus 2X Star	0.55
LG KM900 Arena	1.10
LG KM570 Arena II	0.99
LG E510 Optimus Hub	0.71
HP iPAQ 910	0.79

Исходя из полученных данных, модель самого безопасного телефона Samsung GT-N7000 Galaxy Note, так как значение Specific Absorbtion Rate является наименьшим по сравнению с другими моделями.

А самым вредным является Nokia 900 Lumia RM-823 с уровнем SAR – 1,33.

Для того, чтобы уменьшить вред, который может принести использование сотового телефона, и при этом продолжать пользоваться этим нужным для повседневной жизни прибором, необходимо сократить время сеанса разговора до минимума и выбрать тарифный план по дороже, чтобы не хотелось долго разговаривать. Покупая сотовый телефон, выбирайте тот, у которого минимальный уровень излучения. Если у телефона есть внешняя антенна, не стоит без особой нужды добавлять к ней усилители. Объём излучения уменьшается также при использовании гарнитуры. Телефон в этом случае лучше держать в кармане верхней одежды или сумке, но не в кармане брюк (близко к репродуктивным органам) или на ремешке, надетом на шею. Если вы часто ездите в автомобиле, то установите внешнюю антенну – так вы уменьшите облучение и улучшите связь. В ночное время сотовый телефон следует выключать, если, конечно, вы не являетесь человеком определённой профессии, и не ждёте важных звонков именно по ночам. Сотовый телефон, работая ночью в режиме ожидания, способен нарушать фазы сна. Если вы пользуетесь им как будильником, то проверьте функции – сегодня у большинства телефонов будильник срабатывает, даже если аппарат выключен.

Следуя простым советам, вы сохраните свое здоровье.

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Вакуумные выключатели

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Вакуумный выключатель – это высоковольтный выключатель, в котором вакуум служит средой для гашения электрической дуги. Вакуумный выключатель предназначен для коммутаций (операций включения-отключения) электрического тока, номинального и токов короткого замыкания (КЗ) в электроустановках [1].

Первые разработки вакуумных выключателей были начаты в 30-е годы XX века, действующие модели могли отключать небольшие токи при напряжениях до 40 кВт. Достаточно мощные вакуумные выключатели в те годы так и не были созданы из-за несовершенства технологии изготовления вакуумной аппаратуры и, прежде всего, из-за возникших в то время технических трудностей по поддержанию глубокого вакуума в герметизированной камере [2. ст.350].

В настоящее время выключатели с вакуумными и элегазовыми дугогасящими устройствами (ДУ) начинают все больше вытеснять масляные, электромагнитные и воздушные выключатели. Это значит, что дугогасящие устройства, вакуумные и элегазовые не требуют ремонта, приблизительно, в течение 20 лет, в то время как в масляных выключателях масло при отключениях загрязняется частицами свободного углерода и, кроме того, изоляционные свойства масла снижаются из-за попадания в не-

го влаги и воздуха [3. ст.12]. Это приводит к необходимости смены масла не реже 1 раза в 4 года. Дугогасящие устройства электромагнитных выключателей примерно в такие же сроки требуют очистки от копоти, пыли и влаги; ДУ вакуумных и элегазовых выключателей заключены в герметичные оболочки, и их внутренняя изоляция не подвергается воздействию внешней среды. Электрическая дуга при отключениях в вакууме или в элегазе практически не снижает свойств дугогасящей и изолирующей среды.

Современные выключатели должны обладать коммутационными и механическими ресурсами, обеспечивающими межремонтный период в эксплуатации 15 –20 лет [2. ст.350]. Эти условия трудновыполнимы при традиционных методах гашения дуги в масле или воздухе. Возможности дальнейшего существенного совершенствования выключателей с традиционными способами гашения дуги практически исчерпаны, однако выпуск этих выключателей пока будет продолжаться из-за того, что технология их изготовления проста и их цена ниже вновь осваиваемых воздушных и элегазовых выключателей [4. ст.74].

В СССР разработаны и с 1980 года серийно изготовляются вакуумные выключатели на напряжение 10 кВ с номинальными токами отключения до 80 кА. На сегодняшний день в мире налажен промышленный выпуск высоконадежных быстродействующих вакуумных выключателей способных отключать большие токи в электрических сетях среднего (6, 10, 35 кВ) и высокого напряжения (до 110 кВ включительно) [1].

Принцип действия заключается в следующем, в момент размыкания контактов, в вакуумном промежутке коммутируемый ток инициирует возникновение электрического разряда – вакуумной дуги, существование которой поддерживается за счет металла, испаряющегося с поверхности контактов в вакуумный промежуток [4. ст.70]. Плазма, образованная ионизированными парами металла, проводит электрический ток, поэтому ток протекает между контактами до момента его перехода через ноль. В момент перехода тока через ноль дуга гаснет, а оставшиеся пары металла мгновенно (за 7 –10 микросекунд) конденсируются на поверхности контактов и других деталей дугогасящей камеры, восстанавливая электрическую прочность вакуумного промежутка. В то же время на разведенных контактах восстанавливается приложенное к ним напряжение [4. ст.60].

Существуют такие виды вакуумных выключателей как:

1. вакуумные выключатели до 35 кВ;
2. вакуумные выключатели выше 35кВ;
3. вакуумные выключатели нагрузки – современная замена автогазовым выключателям нагрузки, то есть Автогазовый выключатель;
4. Вакуумные контакторы до и свыше 1000В.

Автогазовый выключатель – это коммутационный аппарат, предназначенный для оперативных коммутаций электрооборудования. В отличие от других типов выключателей гашения электрической дуги осуществляется газами, генерируемыми самим выключателем.

Основные достоинства вакуумных выключателей, определяющие их широкое применение:

1. Высокая износостойкость при коммутации номинальных токов и номинальных токов отключения;
2. Резкое снижение эксплуатационных затрат по сравнению с маломасляными выключателями;
3. Полная взрывобезопасность и пожаробезопасность;

4. Широкий диапазон температур окружающей среды, в котором возможна работа ВДК;
5. Повышенная устойчивость к ударным и вибрационным нагрузкам вследствие малой массы и компактной конструкции аппарата;
6. Произвольное рабочее положение и малые габариты;
7. Бесшумность, чистота, удобство обслуживания;
8. Отсутствие загрязнения окружающей среды;
9. Высокая надежность и безопасность эксплуатации, сокращение времени на монтаж.

К недостаткам ВВ следует отнести повышенный уровень коммутационных перенапряжении, что в ряде случаев вызывает необходимость принятия специальных мер по защите оборудования.

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Технология моделирования управляемого шунтирующего реактора

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Существенное повышение управляемости и эффективности функционирования электроэнергетических систем может быть достигнуто путем применения управляемых технологий и устройств FACTS (Flexible Alternative Current Transmission Systems), к которым относятся: управляемые шунтирующие реакторы (УШР), статические тиристорные компенсаторы (СТК), статические синхронные компенсаторы (СТАТКОМ) и другие. Среди FACTS устройств наиболее распространённым в настоящее время, особенно в российских сетях, является УШР, основные назначения которого: компенсация реактивной мощности для регулирования напряжения и минимизация потерь за счет уменьшения потоков реактивной мощности. В российских сетях, как правило, применяются два типа УШР: УШР трансформаторного типа (УШРТ) и УШР с подмагничиванием (УШРП), которому посвящена данная работа.

УШРП выполняется на общих принципах трансформаторостроения и, как правило, на общем сердечнике реактора располагается сетевая обмотка, компенсирующая обмотка и обмотка управления. Сетевая обмотка является основной рабочей обмоткой, управляющая подключена к регулируемому по значению источнику постоянного напряжения. Каждая из обмоток создает свои магнитные потоки: сетевая обмотка – переменный поток промышленной частоты; управляющая – постоянный, регулируемый по значению поток подмагничивания. Постоянный поток подмагничивания смещает переменный поток в область насыщения кривой намагничивания стали, что и

приводит к изменению индуктивного сопротивления устройства. При насыщении сердечника возникает искажение сигнала, а именно появляется ток третьей гармоники, для ограничения которого применяется соединенная в треугольник компенсационная обмотка [1].

При формировании уравнений, описывающих процессы протекающие в УШРП, учитывается взаимодействие каждой обмотки фазы с собственным основным магнитным потоком и потоком рассеивания. Согласно обозначенному подходу создаваемая математическая модель должна объединять в себе систему уравнений трех фаз трехобмоточного реактора, которая включает в себя:.

1. Уравнения магнитосвязанных потоком фазы контуров каждой обмотки:.

$$w_{COi}\frac{d\Phi_{0i}}{dt}+L_{COi}\frac{di_{Ci}}{dt}+r_{COi}i_{COi}=u_{COi}\quad w_{KOi}\frac{d\Phi_{0i}}{dt}+L_{KOi}\frac{di_{KOi}}{dt}+r_{KOi}i_{KOi}=0$$

$$w_{YOi}\frac{d\Phi_{YOi}}{dt}+L_{YOi}\frac{di_{YOi}}{dt}+r_{YOi}i_{YOi}=u_{YOi}$$, где: w_{ji} – число витков j – ой обмотки; i – фазы A, B, C;

2. Уравнения магнитодвижущих сил для каждой фазы:

$$w_{COi}\cdot i_{COi}+w_{KOi}\cdot i_{KOi}+w_{OYi}\cdot i_{OYi}=F_{намі}\ .$$

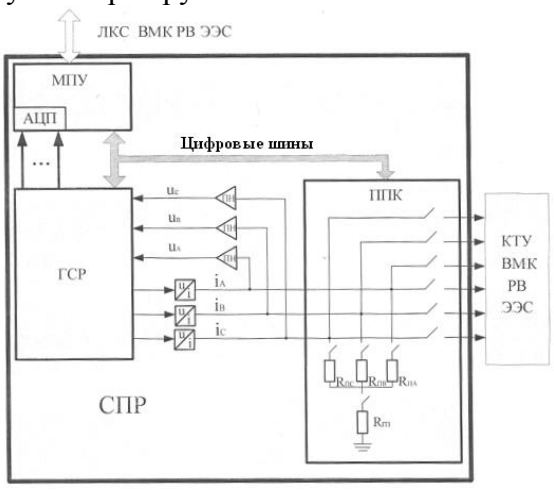
где $F_{намі}$ – намагничивающая сила для фазы i, определяемая с учетом возможного насыщения стали выражением: $F_{намі}=K_{\mu}\Phi_{0i}^{p}$. .

Полученные системы уравнений позволяют синтезировать соответствующую математическую модель УШРП, воспроизводящую процессы в обмотках, с учетом магнитопровода и его нелинейности, а также программно-аппаратной реализации данной модели, которая позволит бездекомпозиционно и непрерывно в реальном времени и на неограниченном интервале осуществлять обработку такого рода математических моделей, содержащих жесткую нелинейную систему дифференциальных уравнений, с гарантированной точностью. Решение такой модели численным путем не эффективно, в связи с необходимым для этого упрощением и ограничением математической модели, и как следствие сокращением полноты и достоверности моделирования.

Создание указанной модели и разработка альтернативного пути решения, а также программно-аппаратных средств, адаптированных для применения в соответствующей среде моделей ЭЭС является весьма актуальной задачей, с решением которой связанна данная работа, включающая синтез обозначенной математической модели и создание программно-аппаратных средств – специализированного процессора УШР (СПР), структура которого изображена на рисунке 1.

В состав СПР входят:

1. Микропроцессорный узел (МПУ), с помощью которого моделируется САУ УШРП и всё информационное управление. МПУ содержит центральный и периферийный микроконтроллер и аналого-цифровой преобразователь. САУ УШРП имеет три канала: по напряжению, по току и по реактивной мощности. Каждый канал содержит защиту от перегрузки и от перенапряжения. Есть режимы форсированной загрузки и разгрузки УШРП. Изменение сопротивления УШРП пропорционально отклонению напряжения, тока или реактивной мощности от уставки.



2. Гибридный сопроцессор реактора (ГСР), с помощью которого осуществляется непрерывное и неявное решение си-

стемы дифференциальных уравнений математической модели УШРП в реальном времени и на неограниченном интервале. Выходные переменные ГСР представляются выходными напряжениями, которые преобразуются с помощью преобразователей u/i в модельные физические токи. Непрерывная информация о напряжениях в выходных узлах с помощью повторителя напряжений вводится в ГСР.

Рисунок 1. Структура специализированного процессора УШР.

3. Для осуществления всевозможного спектра трехфазных и пофазных продольно-поперечных коммутаций (ППК) используется цифро-управляемые аналоговые ключи. Переходное сопротивление коммутации реализуется с помощью цифро-управляемых сопротивлений.

Разработанный подобным образом СПР адаптирован для использования во Всережимном моделирующем комплексе реального времени электроэнергетических систем, который был создан в Энергетическом институте Томского политехнического университета [2].

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Дальние электропередачи переменного и постоянного тока на сверхвысоких напряжениях

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В данной статье мной будут рассмотрены основные вопросы, связанные с теорией передачи электрической энергии переменным и постоянным током, преимущества передачи электроэнергии на сверхвысоких напряжениях, влияние напряжения электропередач на их эффективность. Также статья содержит общие понятия и сведения об энергетических системах и линиях электропередач.

1.Роль электропередач сверхвысокого напряжения в энергетических системах

Электропередачи сверхвысокого напряжения занимают особое место в современных энергетических системах и играют важную роль в современной энергетике, являясь связывающим элементом во всей энергосистеме страны. Обладая большой пропускной способностью, такие передачи являются системообразующими линиями и повышают надежность и экономичность работы энергосистемы. Человечество все время старается повысить напряжение в электропередачах для повышения их эффективности. Развитие энергетических систем во всем мире характеризуется процессом их слияния во все более крупные объединения. Этот процесс сопровождается сооружением мощных межсистемных связей, характер которых определяется удаленностью объединяемых систем и условиями баланса активной мощности в каждой из частей объединенной системы в тот или ной период времени. При этом, задача передачи электрической энергии на расстояние не сводится только лишь к транспорту электроэнергии или выдаче мощности крупных станций в сеть. Серьезной является другая

задача- образование электрических систем, без которых нельзя представить себе развитие современной и тем более будущей энергетики. Таким образом электропередачи объединяют энергетические системы, что увеличивает надежность работы систем и обеспечивает наивыгоднейшие режимы работы этих систем.

2. Конструктивные особенности линий сверхвысокого напряжения

Одной из основных особенностей воздушных линий сверхвысокого напряжения являются расщепленные провода фаз, то есть каждая фаза линии выполняется в виде специальной конструкции из нескольких проводов, расположенных по вершинам правильного многоугольника на определенном расстоянии друг от друга. Число проводов в фазе может колебаться от 2 до 10 и более в зависимости от класса напряжения линии, так, например, на линиях 330 кВ применяются два провода в фазе, в то время как для линий 1150 кВ используют 8-10 проводов. Причины использования расщепленной фазы обуславливаются несколькими факторами: увеличением пропускной способности, снижением напряженности и как следствие уменьшением генерации помех для высокочастотной связи.

3. Виды энергетических систем

Электроэнергетической системой называется объединение отдельных электростанций линиями электропередачи на параллельную работу для электроснабжения потребителей, такая энергетическая система управляется диспетчерским управлением Рассматривая различные электроэнергетические системы, можно заметить, что они различаются между собой по соотношению мощностей станций, входящих в состав системы, а также по режимам нагрузки. Таким образом энергетические системы могут быть разделены на пять типов:

1) Гидроэнергетические, имеющие в своем составе более 50% ГЭС(по энергии). Наличие равнинных или горных гидростанций существенно влияет на основные энергоэконоические характеристики гидроэнергетических систем и их объединений.
2) Теплофикационные системы, более 50% ТЭЦ.
3) Конденсационные, имеющие в своем составе конденсационные агрегаты, в том числе на атомных электростанциях, выработкой более 50%.
4) Системы, характеризующиеся примерно равным соотношением всех 3 типов электростанций.
5) Энергетические системы, состоящие только из ГЭС и ТЭЦ, обладающие весьма совершенными энергоэкономическими характеристиками.

Но иногда возможно существование систем с так называемой подвижной структурой. Так, объединение систем происходит с помощью секционирования электростанций, крупные агрегаты которой могут работать то в одной, то в другой системе, что приводит к системе подвижной структуры, то есть при смене внешних воздействий, которые могут отрицательно сказаться на выгодности поставок электроэнергии, система по распоряжению диспетчера может изменять свою структуру для поддержания производства электроэнергии на стандартном уровне.

4. Передача электроэнергии на постоянном и переменном токе. Преимущества и недостатки

Как известно, существует 2 способа передачи электроэнергии: на переменном и постоянном токе. В зависимости от факторов выбирается наиболее подходящий тип тока для наиболее эффективного и экономичного транспорта электроэнергии. Главным плюсом постоянного тока является то, что допустимая напряженность электрического поля для кабелей постоянного тока в 5 – 6 раз выше, чем для кабелей пере-

менного тока. Для примера можно сказать, что кабели, рассчитанные для работы с номинальным напряжением 35 кВ переменного тока, могут быть использованы для постоянного тока напряжением 200 кВ. Поэтому, несмотря на большую стоимость, передачи постоянного тока с кабельными линиями при длинах 30 –40 км становятся соизмеримыми по стоимости с кабельными передачами переменного тока или даже выгоднее их. Но если передачи на постоянном токе выгоднее и эффективнее, почему же тогда в некоторых случаях используются передачи на переменном токе? Прежде всего потому, что недостатками передач постоянного являются значительные трудности при выполнении промежуточных отборов мощности и высокая стоимость преобразовательных подстанций, которые нужны для преобразования постоянного тока в переменный ток, который используется в быту. Из-за этого сохраняется интерес к проблеме увеличения пропускной способности электропередач переменного тока, основным средством достижения этой цели является повышение их номинального напряжения, для того, чтобы увеличить эффективность и КПД передач на переменном токе. Таким образом, с учётом затрат на изменения тока с постоянного на переменный, при дальних электропередачах постоянный ток будет более выгодный, чем переменный, а при локальных- наоборот.

В заключение необходимо еще раз подчеркнуть всю важность электропередач, не только с точки зрения передачи энергии, но также с точки зрения создания энергетических систем, без которых невозможно представить современную энергетику. Одной из главных задач современной энергетики является повышение мощности передач на переменном токе из-за того, что переменный ток более выгоден в экономическом плане, но уступает в мощности передачам на постоянном токе, что сказывается на передачах энергии на большие расстояния.

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Электрическая лампочка

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Современному человеку трудно представить, что всего сто с небольшим лет назад электрические лампочки в нашем быту делали свои первые шаги.

Список изобретателей большинства современных устройств, как правило, ограничивается одной-двумя персонами. Существуют и весьма интересные исключения из этого правила. Например, лампа накаливания. Поверить в то, что простую лампочку изобрел не один, а тринадцать ученых, довольно сложно. Та лампа, которую мы используем сегодня, существенно отличается от той, которая была изобретена.

Русский и английский физики Василий Петров и Деви положили начало изобретению лампочки. Они оба получили вольтову дугу, пользуясь большой батареей элементов, между концами стерженьков из древесного угля. Оба физика сделали вывод, что вольтова дуга может использоваться в целях освещения. Стержни из древесного угля сгорали за несколько минут и были малопригодны для практического использования.

Если взять две проволоки, подключить их к достаточно сильному источнику тока, соединить, а затем раздвинуть на расстояние нескольких миллиметров, то между концами проводников образуется нечто вроде пламени с ярким светом. Эффект будет красивее и ярче, если вместо металлических проводов взять два заостренных угольных стержня.

Англичанин Деларю, создал в 1809 году первую лампочку накаливания с платиновой нитью. Первую дуговую лампу с ручным регулированием длины дуги сконструировал в 1844 году французский физик Фуко. Древесный уголь он заменил палочками из твердого кокса. В 1848 году он впервые применил дуговую лампу для освещения одной из парижских площадей.

В 1875 году Павел Яблочков предложил простое решение для дуговых ламп. Он расположил угольные электроды параллельно, разделив их изолирующим слоем. Изобретение имело колоссальный успех. Всемирная выставка, открывшаяся в 1878 году, познакомила многих электротехников с этим замечательным изобретением. Под названием «русский свет» свечи Яблочкова использовались позже для уличного освещения во многих городах мира.

В 1874 году инженер Александр Лодыгин запатентовал «нитевую лампу». В качестве нити накала использовался угольный стержень, помещенный в сосуд с вакуумом. В 1890 году Лодыгин придумал заменить угольную нить проволокой из тугоплавкого вольфрама, с температурой накала 3385 градусов. В 1906 году Лодыгин продаёт патент на вольфрамовую нить компании General Electric. Из-за высокой стоимости вольфрама изобретение находит ограниченное применение.

Настоящий переворот в создании лампочки совершили опыты американского изобретателя Эдисона. Он разработал подробные схемы электростанции и коммуникационных линий к зданиям. Подсчитал себестоимость всех материалов и вычислил, что цена лампочки для потребителя не должна превышать 40 центов.

С 1878 года он провел более 12 тысяч опытов в своей лаборатории. Его помощники опробовали не менее 6000 различных веществ и соединений, на опыты было израсходовано свыше 100 тысяч долларов.

Эдисон заменил ломкий бумажный уголек более прочным, приготовленным из угля, потом стал делать опыты с различными металлами и, наконец, остановился на нити из обугленных бамбуковых волокон. В 1879 году в присутствии трех тысяч человек Эдисон публично демонстрировал свои электрические лампочки, осветив ими свой дом и несколько прилегающих улиц.

Это была первая лампочка с продолжительным сроком службы, пригодная для массового производства.

Заслуга Эдисона не в том, что изобрел лампочку, а в том, что он дал начало промышленному производству ламп и ее составляющих: кабелей, двухфазных генераторов и электросчетчиков. Патрон и цоколь, а также многие другие элементы электрического освещения, сохранившиеся без изменений до наших дней – выключатели, предохранители, электрические счетчики и многое другое – были также изобретены Эдисоном.

Средняя долговечность лампочки Эдисона составляла 800-1000 часов непрерывного горения. Почти тридцать лет лампочки изготавливались способом который разработал Эдисон.

Начало XX-го века – это первые попытки наладить массовое производство лампочек с вольфрамовыми нитями накаливания. Это стало возможным лишь в 1906-м году благодаря усилиям Александра Лодыгина и Вильяма Кулиджа, трудившихся над доступными методами получения вольфрамовой нити. В 1910 году Вильям Кулидж изобретает улучшенный метод производства вольфрамовой нити. Впоследствии вольфрамовая нить вытесняет все другие виды нитей.

Последний этап усовершенствования лампочки – использование благородных инертных газов для заполнения полости лампы. Благодаря этому нововведению, предложенному Ирвингом Ленгмюром, современные лампочки не только ярки, но и долговечны.

Конструкции ламп накаливания весьма разнообразны и зависят от их назначения. Общими являются тело накала, колба и токовводы. В зависимости от особенностей конкретного типа лампы могут применяться держатели тела накала различной конструкции. Крючки-держатели тела накала ламп накаливания (в том числе ламп накаливания общего назначения) изготовляются из молибденах[1]. Лампы могут изготавливаться бесцокольными или с цоколями различных типов, иметь дополнительную внешнюю колбу и иные дополнительные конструктивные элементы.

В конструкции ламп общего назначения предусматривается предохранитель – звено из ферроникелевого сплава, вваренное в разрыв одного из токовводов и расположенное вне колбы лампы – как правило, в ножке. Назначение предохранителя – предотвратить разрушение колбы при обрыве нити накала в процессе работы. Дело в том, что при этом в зоне разрыва возникает электрическая дуга, которая расплавляет остатки нити, капли расплавленного металла могут разрушить стекло колбы и послужить причиной пожара. Предохранитель рассчитан таким образом, чтобы при зажигании дуги он разрушался под воздействием тока дуги, существенно превышающего номинальный ток лампы. Ферроникелевое звено находится в полости, где давление равно атмосферному, поэтому дуга легко гаснет. В настоящее время от их применения отказались из-за малой эффективности.

По функциональному назначению и особенностям конструкции лампы накаливания подразделяют на:

- лампы общего назначения (до середины 1970-х годов применялся термин «нормально-осветительные лампы»). Самая массовая группа ламп накаливания, предназначенных для целей общего, местного и декоративного освещения. Начиная с 2008 года за счёт принятия рядом государств законодательных мер, направленных на сокращение производства и ограничение применения ламп накаливания с целью энергосбережения, их выпуск стал сокращаться;
- декоративные лампы, выпускаемые в фигурных колбах. Наиболее массовыми являются свечеобразные колбы диаметром около 35 мм и сферические диаметром около 45 мм;
- лампы местного освещения, конструктивно аналогичные лампам общего назначения, но рассчитанные на низкое (безопасное) рабочее напряжение – 12, 24 или 36 (42) В. Область применения – ручные (переносные) светильники, а также светильники местного освещения в производственных помещениях (на станках, верстаках, где возможен случайный бой лампы);

- иллюминационные лампы, выпускаемые в окрашенных колбах. Назначение – иллюминационные установки различных типов. Как правило, лампы этого вида имеют малую мощность (10-25 Вт). Окрашивание колб обычно производится за счёт нанесения на их внутреннюю поверхность слоя неорганического пигмента. Реже используются лампы с колбами, окрашенными снаружи цветными лаками (цветным цапонлаком), их недостаток – быстрое выцветание пигмента и осыпание лаковой плёнки из-за механических воздействий;
- зеркальные лампы накаливания имеют колбу специальной формы, часть которой покрыта отражающим слоем (тонкая плёнка термически распылённого алюминия). Назначение зеркализации – пространственное перераспределение светового потока лампы с целью наиболее эффективного его использования в пределах заданного телесного угла. Основное назначение зеркальных ЛН – локализованное местное освещение;
- сигнальные лампы используются в различных светосигнальных приборах (средствах визуального отображения информации). Это лампы малой мощности, рассчитанные на длительный срок службы, в настоящее время вытесняются светодиодами;
- транспортные лампы – чрезвычайно широкая группа ламп, предназначенных для работы на различных транспортных средствах (автомобилях, мотоциклах и тракторах, самолётах и вертолётах, локомотивах и вагонах железных дорог и метрополитенов, речных и морских судах). Характерные особенности: высокая механическая прочность, вибростойкость, использование специальных цоколей, позволяющих быстро заменять лампы в стеснённых условия и, в то же время, предотвращающих самопроизвольное выпадение ламп из патронов. Рассчитаны на питание от бортовой электрической сети транспортных средств (6-220 В);
- прожекторные лампы обычно имеют большую мощность (до 10 кВт, ранее выпускались лампы до 50 кВт) и высокую световую отдачу. Используются в световых приборах различного назначения (осветительных и светосигнальных);
- лампы для оптических приборов, к числу которых относятся и выпускавшиеся массово до конца XX века лампы для кинопроекционной техники, имеют компактно уложенные спирали, многие помещаются в колбы специальной формы. Используются в различных приборах (измерительные приборы, медицинская техника и т. п.);
- коммутаторные лампы – разновидность сигнальных ламп. Они служили индикаторами на коммутаторных панелях. Представляют собой узкие длинные миниатюрные лампы с гладкими параллельными контактами, что позволяет легко их заменять. Выпускались варианты: КМ 6-50, КМ 12-90, КМ 24-35, КМ 24-90, КМ 48-50, КМ 60-50, где первая цифра означает рабочее напряжение в вольтах, вторая – силу тока в миллиамперах;
- Фотолампа, перекальная лампа – разновидность лампы накаливания, предназначенная для работы в строго нормированном форсированном по напряжению режиме. По сравнению с обычными имеет повышенную световую отдачу (до 30 лм/Вт), малый срок службы (4-8 часов) и высокую цветовую температуру (3300-3400К, по сравнению с 2700 К). В СССР выпускались фотолампы мощностью 300 и 500 Вт. Как правило, имеют матированную колбу. В настоящее время практически вышли из употребления, благодаря появлению более долговечных устройств сравнимой и

более высокой эффективности. В фотолабораториях обычно осуществлялось питание таких ламп в двух режимах:.

- Пилотное освещение – напряжение снижено на 20-30 % с помощью ЛАТРа. При этом лампа работает с недокалом и имеет низкую цветовую температуру.
- Номинальное напряжение.[3].

У ламп накаливания есть свои преимущества и недостатки.

Преимущества:

1) высокий индекс цветопередачи, Ra 100;
2) налаженность в массовом производстве;
3) низкая цена;
4) небольшие размеры;
5) отсутствие пускорегулирующей аппаратуры;
6) нечувствительность к ионизирующей радиации;
7) чисто активное электрическое сопротивление (единичный коэффициент мощности);
8) мгновенное зажигание и перезажигание;
9) невысокая чувствительность к сбоям в питании и скачкам напряжения;
10) отсутствие токсичных компонентов и как следствие отсутствие необходимости в инфраструктуре по сбору и утилизации;
11) возможность работы на любом роде тока;
12) нечувствительность к полярности напряжения;
13) возможность изготовления ламп на самое разное напряжение (от долей вольта до сотен вольт);
14) незаметность мерцания для 60 Вт, при больших мощностях коэффициент пульсаций меньше) при работе на переменном токе (важно на предприятиях);
15) отсутствие гудения при работе на переменном токе;
16) непрерывный спектр излучения;
17) приятный и привычный в быту спектр;
18) устойчивость к электромагнитному импульсу;
19) возможность использования регуляторов яркости;
20) не боятся низкой и повышенной температуры окружающей среды, устойчивы к конденсату.

Недостатки:

1) низкая световая отдача;
2) относительно малый срок службы;
3) хрупкость, чувствительность к удару и вибрации;
4) бросок тока при включении (примерно десятикратный);
5) при термоударе или разрыве нити под напряжением возможен взрыв баллона;
6) резкая зависимость световой отдачи и срока службы от напряжения;
7) лампы накаливания представляют пожарную опасность. Через 30 минут после включения ламп накаливания температура наружной поверхности достигает, в зависимости от мощности, следующих величин: 25 Вт – 100 °С, 40 Вт – 145 °С, 75 Вт – 250 °С, 100 Вт – 290 °С, 200 Вт – 330 °С. При соприкосновении ламп с текстильными материалами их колба нагревается ещё сильнее. Солома, касающаяся поверхности лампы мощностью 60 Вт, вспыхивает примерно через 67 минут;
8) нагрев частей лампы требует термостойкой арматуры светильников;

9) световой коэффициент полезного действия ламп накаливания, определяемый как отношение мощности лучей видимого спектра к мощности, потребляемой от электрической сети, весьма мал и не превышает 4 %. Включение электролампы через диод, что часто применяется с целью продления ресурса на лестничных площадках, в тамбурах и прочих затрудняющих замену местах, ещё больше усугубляет её недостаток: значительно уменьшается КПД, а также появляется значительное мерцание света.[3].

Сейчас современная наука делает такое простое и такое незаменимое изобретение как лампочка еще проще и эффективнее, но имена тех, кто трудился над ее созданием в прошлом, уже записаны золотыми буквами в историю мировой науки.

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ЧАСТЬ II

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