Ministry of Education and Science of the Republic of Kazakhstan
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POWER PRODUCTION

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POWER ENGINEERING

A STEAM TURBINE USED TO PROVIDE ELECTRIC POWER.

POWER ENGINEERING, ALSO CALLED **POWER SYSTEMS ENGINEERING**, IS A SUBFIELD OF ELECTRICAL ENGINEERING THAT DEALS WITH THE GENERATION, TRANSMISSION, DISTRIBUTION AND UTILIZATION OF ELECTRIC POWER, AND THE ELECTRICAL APPARATUS CONNECTED TO SUCH SYSTEMS. ALTHOUGH MUCH OF THE FIELD IS CONCERNED WITH THE PROBLEMS OF THREE-PHASE AC POWER – THE STANDARD FOR LARGE-SCALE POWER TRANSMISSION AND DISTRIBUTION ACROSS THE MODERN WORLD – A SIGNIFICANT FRACTION OF THE FIELD IS CONCERNED WITH THE CONVERSION BETWEEN AC AND DC POWER AND THE DEVELOPMENT OF SPECIALIZED POWER SYSTEMS SUCH AS THOSE USED IN AIRCRAFT OR FOR ELECTRIC RAILWAY NETWORKS. POWER ENGINEERING DRAWS THE MAJORITY OF ITS THEORETICAL BASE FROM ELECTRICAL ENGINEERING.

Energy — the area of economic activity of man, a set of large natural and artificial subsystems, serving for the transformation, distribution and use of energy resources of all kinds. Its purpose is to ensure the production of energy by converting primary, natural energy into secondary, such as electrical or thermal energy. In this case, energy production often occurs in several stages:

production and concentration of energy resources, an example is the extraction, processing and enrichment of nuclear fuel;

transfer of resources to power plants, e.g. delivery of gas, coal, fuel oil to a thermal power plant;

conversion of primary energy into secondary energy, e.g. coal chemical energy, into electrical and thermal energy by means of power plants;

transmission of secondary energy to consumers, for example via power lines.

Contents

1 History

Main article: History of electrical engineering

Electricity has been a subject of scientific interest since at least the early 17th century. William Gilbert was a prominent early electrical scientist, and was the first to draw a clear distinction between magnetism and static electricity. He is credited with establishing the term "electricity". He also designed the versorium: a device that detects the presence of statically charged objects. In 1762 Swedish professor Johan Carl Wilcke invented a device later named electrophorus that produced a static electric charge. By 1800 Alessandro Volta had developed the voltaic pile, a forerunner of the electric battery .

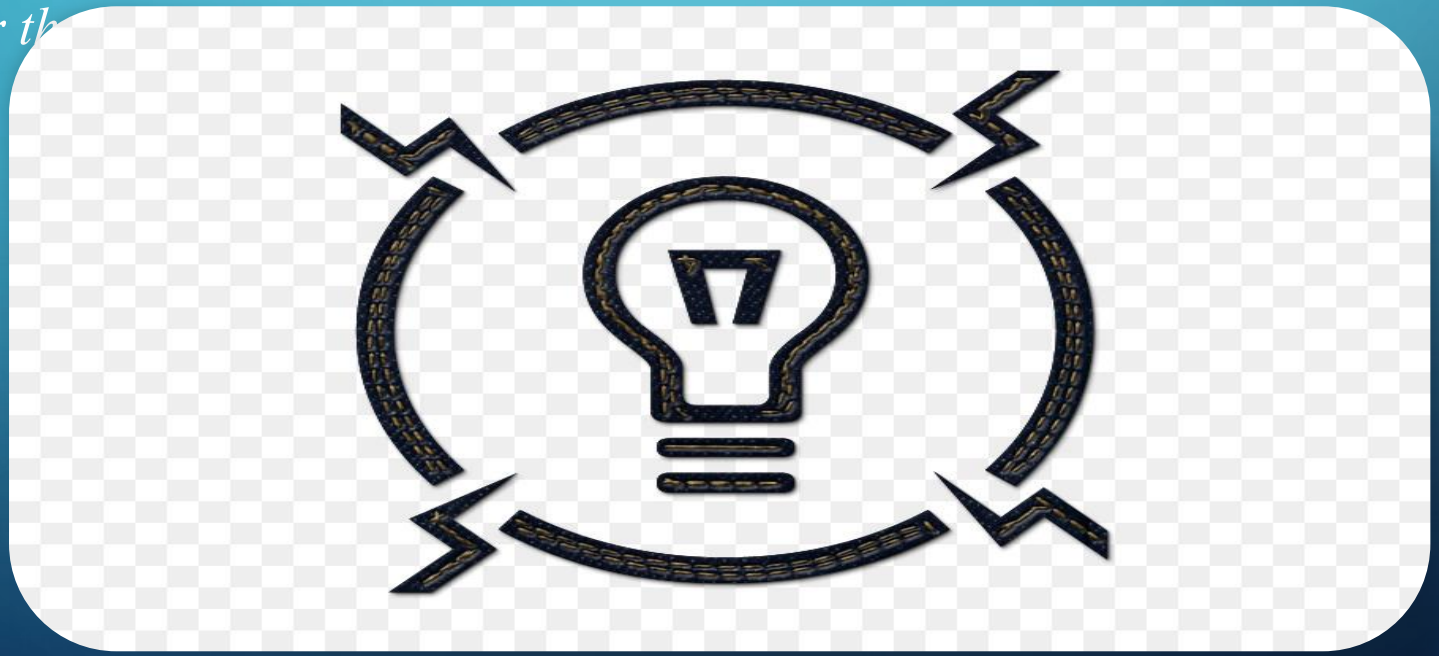
2 Pioneering years

Electricity became a subject of scientific interest in the late 17th century. Over the next two centuries a number of important discoveries were made including the incandescent light bulb and the voltaic pile. Probably the greatest discovery with respect to power engineering came from Michael Faraday who in 1831 discovered that a change in magnetic flux induces an electromotive force in a loop of wire—a principle known as electromagnetic induction that helps explain how generators and transformers work. In 1881 two electricians built the world's first power station at Godalming in England. The station employed two waterwheels to produce an alternating current that was used to supply seven Siemens arc lamps at 250 volts and thirty-four incandescent lamps at 40 volts. However supply was intermittent and in 1882 Thomas Edison and his company, The Edison Electric Light Company, developed the first steam-powered electric power station on Pearl Street in New York City. The Pearl Street Station consisted of several generators and initially powered around 3,000 lamps for 59 customers. The power station used direct current and operated at a single voltage. Since the direct current power could not be easily transformed to the higher voltages necessary to minimise power loss during transmission, the possible distance between the generators and load was limited to around half-a-mile (800 m).

3.1 Power engineering and Bolshevism

1929 poster by Gustav Klutsis

The generation of electricity was regarded as particularly important following the Bolshevik seizure of power. Lenin stated "Communism is Soviet power plus the electrification of the whole country." He was subsequently featured on many Soviet posters, stamps etc. presenting this view. The GOELRO plan was initiated in 1920 as the first Bolshevik experiment in industrial planning and in which Lenin became personally involved. Gleb Krzhizhanovsky was another key figure involved, having been involved in the construction of a power station in Moscow in 1910. He had also known Lenin since 1897 when they were both in the St. Petersburg chapter of the *Union of Struggle for th*



3.2 Power engineering in the USA

In 1936 the first commercial high-voltage direct current (HVDC) line using mercury-arc valves was built between Schenectady and Mechanicville, New York. HVDC had previously been achieved by installing direct current generators in series (a system known as the Thury system) although this suffered from serious reliability issues. In 1957 Siemens demonstrated the first solid-state rectifier (solid-state rectifiers are now the standard for HVDC systems) however it was not until the early 1970s that this technology was used in commercial power systems.[18] In 1959 Westinghouse demonstrated the first circuit breaker that used SF_6 as the interrupting medium. SF_6 is a far superior dielectric to air and, in recent times, its use has been extended to produce far more compact switching equipment (known as switchgear) and transformers.[20][21] Many important developments also came from extending innovations in the ICT field to the power engineering field. For example, the development of computers meant load flow studies could be run more efficiently allowing for much better planning of power systems. Advances in information technology and telecommunication also allowed for much better remote control of the power system's switchgear and generators.

4 Power

Transmission lines transmit power across the grid.

Power Engineering deals with the generation, transmission, distribution and utilization of electricity as well as the design of a range of related devices. These include transformers, electric generators, electric motors and power electronics.
Power engineers may also work on systems that do not connect to the grid. These systems are called off-grid power systems and may be used in preference to on-grid systems for a variety of reasons. For example, in remote locations it may be cheaper for a mine to generate its own power rather than pay for connection to the grid and in most mobile applications connection to the grid is simply not practical.

5 Fields

Electricity generation covers the selection, design and construction of facilities that convert energy from primary forms to electric power.

Electric power transmission requires the engineering of high voltage transmission lines and substation facilities to interface to generation and distribution systems. High voltage direct current systems are one of the elements of an electric power grid.

Electric power distribution engineering covers those elements of a power system from a substation to the end customer.

Power system protection is the study of the ways an electrical power system can fail, and the methods to detect and mitigate for such failures.

In most projects, a power engineer must coordinate with many other disciplines such as civil and mechanical engineers, environmental experts, and legal and financial personnel. Major power system projects such as a large generating station may require scores of design professionals in addition to the power system engineers. At most levels of professional power system engineering practice, the engineer will require as much in the way of administrative and organizational skills as electrical engineering knowledge.

6 Professional societies

In both the UK and the USA, professional societies had long existed for civil and mechanical engineers. The IEE was founded in the UK in 1871, and the AIEE in the United States in 1884. These societies contributed to the exchange of electrical knowledge and the development of electrical engineering education.

7 Traditional electric power industry

A characteristic feature of the traditional electric power industry is its long-standing and good development, it has undergone a long test in various operating conditions. The main share of electricity throughout the world is received at traditional power plants, their unit electric power often exceeds 1000 MW. Traditional electric power industry is divided into several areas .

7.1 Thermal power

Main article: Thermal Engineering

In this industry, electricity is produced at thermal power plants (TPP), using for this the chemical energy of organic fuel. They are divided into:

1. Steam turbine power plants, where energy is converted using a steam turbine plant;
2. Gas turbine power plants, where energy is converted using a gas turbine plant;
3. Steam-gas power plants, where energy is converted using a steam-gas plant .

Thermal power engineering prevails on a global scale among traditional types, coal is used to produce 46% of the world's electricity, 18% for gas, 3% for biomass burning, oil is used for 0.2%. In total, thermal plants provide about 2/3 of the total output of all power plants in the world.

The energy of such countries as Poland and South Africa is almost entirely based on the use of coal, and the Netherlands - gas. The share of thermal power in China, Australia, Mexico is very high.

7.2 Hydropower

Main article: Hydropower

In this industry, electricity is produced at hydroelectric power plants (HPP), using for this energy of water flow.

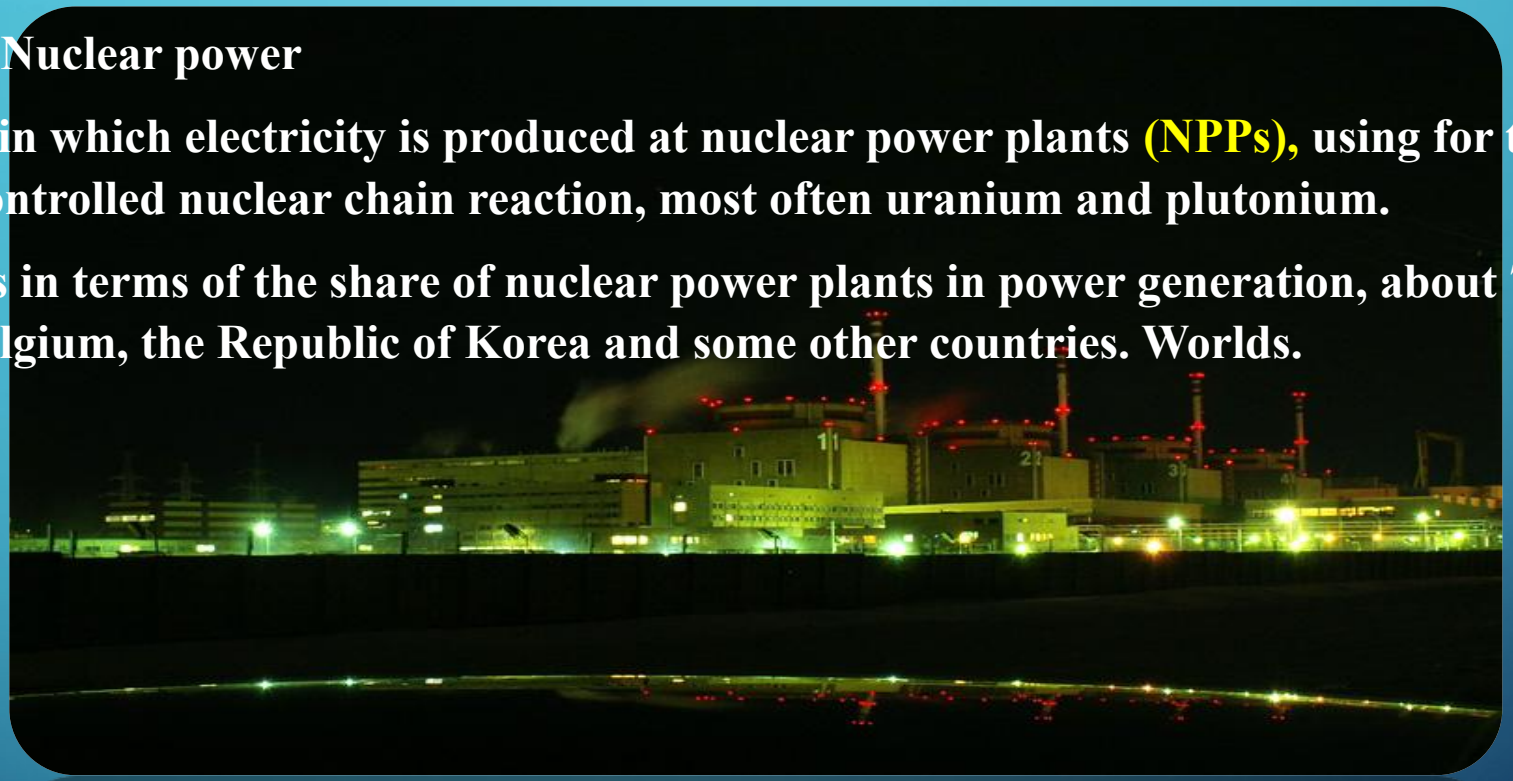
Hydroelectric power plants dominate in a number of countries - in Norway and Brazil, all power generation takes place on them. The list of countries in which the share of hydropo

7.3 Nuclear power

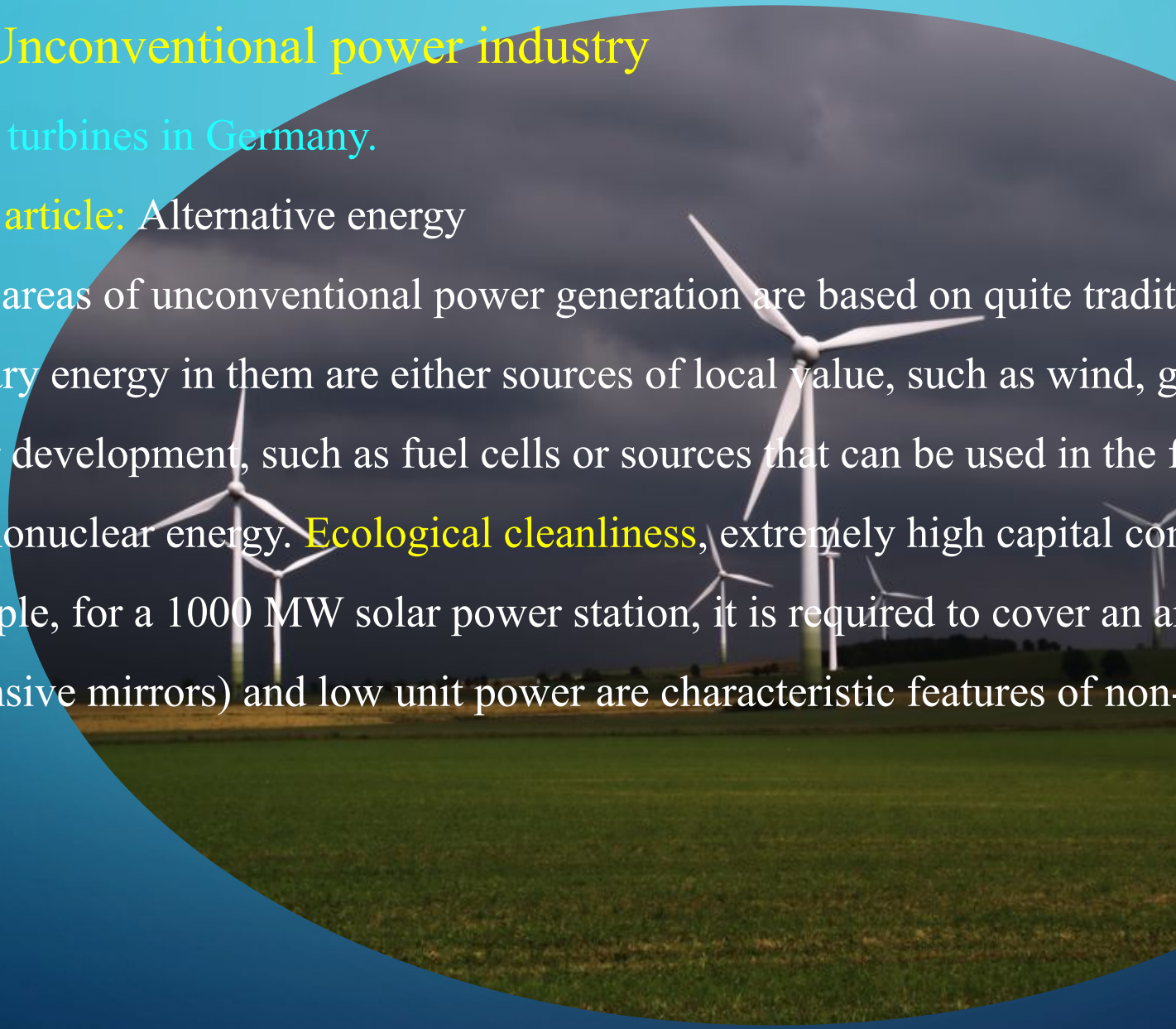
Main article: Nuclear power

The industry in which electricity is produced at nuclear power plants (NPPs), using for this the energy of a controlled nuclear chain reaction, most often uranium and plutonium.

France excels in terms of the share of nuclear power plants in power generation, about 70%. It also prevails in Belgium, the Republic of Korea and some other countries. Worlds.



7.4 Unconventional power industry



Wind turbines in Germany.

Main article: Alternative energy

Most areas of unconventional power generation are based on quite traditional principles, but the primary energy in them are either sources of local value, such as wind, geothermal, or sources under development, such as fuel cells or sources that can be used in the future, such as thermonuclear energy. Ecological cleanliness, extremely high capital construction costs (for example, for a 1000 MW solar power station, it is required to cover an area of 4 km ² with very expensive mirrors) and low unit power are characteristic features of non-conventional energy.

Directions of non-conventional energy :

- Small hydropower plants
- Wind power
- Geothermal energy
- Solar power
- Bioenergy
- Fuel Cell Installations
- Hydrogen energy
- Thermonuclear energy.

It is also possible to single out an important concept because of its mass character - small energy, this term is not generally accepted today, along with it the terms local energy, distributed energy, autonomous energy, etc. are used . Most often this is the name of a power plant with a capacity of up to 30 MW with units of unit capacity of up to 10 MW. These include both environmentally friendly types of energy listed above and small fossil-fueled power plants, such as diesel power plants (the majority of small power plants, for example, in Russia, about 96%), gas piston power plants, gas turbine plants of small diesel and gas power.

8 Electrical networks

Electrical substation in Baghdad, Iraq.

Main article: Electrical network.

Electrical network - a set of substations, switchgears and power transmission lines connecting them, designed to transmit and distribute electrical energy. The electrical network provides the possibility of issuing the power of power plants, its transmission over a distance, the conversion of electric power parameters (voltage, current) at substations and its distribution over the territory up to direct electrical receivers.

Electric networks of modern power systems are multistage, that is, electricity undergoes a large number of transformations on the way from sources of electricity to its consumers. Also, modern electric networks are characterized by multi-mode, which means a variety of network elements loading in daily and annual terms, as well as an abundance of modes arising from the withdrawal of various network elements to scheduled repairs and their emergency shutdowns. These and other characteristics of modern power grids make their structures and configurations very complex and diverse.

The end

Thanks for your attention!!!