# Power plants in modern power supply networks

The modern world is impossible to imagine without a sufficient amount and appropriate **distribution of electricity**. The basic unit in the system of its production is a **power plant** that supplies electricity to industrial and domestic consumers.

The main role in the **distribution of generation capacity** is played by thermal power plants (TPPs), nuclear (NPPs) and hydroelectric power plants (HPPs) are also important. Taken together, these three most advanced types of generation produce the lion's share of electricity in the world. Given the emergence of alternative energy sources and the peculiarities of the conservative sources, a modern **electricity distribution system** is being rebuilt, thanks to which each user gets the opportunity to buy electricity at a reasonable price for a given period of time or sell surplus electricity of own generation. As a result, a new type of power system has emerged - **a distributed, smart power system**. Let's ask questions:

1. Can a **power plant** generate electricity without harming the environment?
2. How you can get electricity and heat without harming the environment.

Recently, alternative means of energy production have been actively developed to help solve the problem of environmental safety and meet the needs of consumers in a particular region. Among them, first of all, are solar panels, wind turbines. Low-potential energy and biofuels are used to generate thermal energy. Today, their share in the **electricity distribution system** is quite small. But experts believe that in the future, these new industries will grow rapidly and play a more important role in **distributed energy systems**. Therefore, in the near future, **electricity distribution systems** should be planned taking into account new sources of electricity generation in the **distribution network** and the capabilities of small local **power plants**.

## Flexible capacity allocation to meet user needs

Nowadays, the demand for electricity is much higher than the need for primary energy. Even charging a car with electricity from environmentally friendly sources is becoming a daily affair. An electric heating boiler instead of a gas or solid fuel boiler is becoming more common. Therefore, the basis of efficient operation of the electricity system of each country is the optimal **distribution of electricity capacity** produced in a given region in one way or another. To do this, it is necessary to take into account both the ability of **power plants** to produce a certain amount of energy and the needs of local **power networks**.

Having a single state regulation allows you to **distribute electricity** during peak hours and avoid related emergencies. Connections with the **electricity distribution systems** of other countries and integration into the international energy security system are also important. This is facilitated by the greater flexibility of modern **electrical networks** and their ability to transmit large amounts of electricity over long distances. The following aspects of modernization of **electric distribution** are extremely important:

- Increasing the capacity of transmission lines;
- Increasing the level of flexibility in the management of **distribution networks**, their ability to respond quickly to changes in power supply regimes;
- Improving electricity quality by stabilizing voltage and frequency;
- Use of new communication systems to manage and control the change of modes in **electricity distribution networks**.

All this should allow for the best **distribution of power** and avoid accidents involving excessive load on one or another part of the **electrical network**.

## The level of losses in electrical networks and ways to reduce them

Let's ask the question: Is it possible to avoid losses during transportation and **distribution of electricity**?

The technological process of energy transfer from the producer to the end point of consumption involves a certain level of losses during transportation in **distribution networks**. According to the main factors, they are divided into technological and non-technological.

Technological losses are physically caused by the process of supplying electricity from one or another **power plant** to the consumer. The **engineering of the electricity distribution system** involves their minimization and the use of special tools and mathematical models for their accounting. Due to this, it is possible to introduce new technologies and carry out the reconstruction of **electrical distribution systems** in those areas that can give the greatest economic effect. The technological share of losses may be due to excessive loads or is a constant component of the energy transmission process in the **electricity distribution network**.

Non-technological losses are due to malfunctions of technological equipment, or insufficient accounting in the network that distributes energy among end users. These include losses from theft, the cause of which is the presence of unregistered and homeless consumers. Accounting errors during transmission in the **distribution and consumption grid** must also be taken into account. Using the latest accounting systems in the **distribution network** helps to solve this problem effectively.

The operation of a **typical distribution network**, the total loss of which does not exceed eight or eight and a half percent, is considered economically justified. If this figure is much higher, the **electrical distribution system** is not working efficiently enough and needs to be upgraded.

The impact of new technologies on the efficiency of transportation and distribution of electricity

The introduction of modern technological developments in the field of transportation and **distribution of electricity** helps to minimize losses and brings the industry to a new level of efficiency and safety. First of all it is necessary to name the following main directions of modernization of **electric networks**:

- Use of better wires;
- New **types of electrical distribution system**;
- Transmission of electricity by direct current of ultrahigh voltage;
- Introduction of **distributed generation in the power system**, thanks to which it is possible to increase the reliability of the **distribution network**;
- Improving the design of power transformers and optimizing **power distribution**;
- Introduction of **electricity distribution automation system**
- New ways of storing electricity
- Automation of accounting in **electricity distribution networks**.

New wire manufacturing technologies avoid overloads in the system. They are also able to reduce losses in the transportation and **distribution of electricity** and increase the stability of the structure during strong winds and ice.

Recently, hybrid transmission systems are more commonly used in **electrical distribution systems**. In this case, a combination of standard transmission lines and high-voltage direct current lines is provided.

In connection with the emergence of new concepts of **distributed power system** there are a number of problems related to effective control of **electrical distribution** and increase the reliability of all components of this system, as well as the need to reserve significant amounts of energy for further use during peak hours in **power distribution systems**. Therefore, the role of electricity storage technologies is growing, which make it possible to balance the imbalance in the **power grids** dependent on solar energy and wind **power plants**. The most powerful energy storage container based on nickel-cadmium batteries is built in Alaska.

### Efficiency of investments in the electric distribution system

- Does a **typical electricity grid** require a constant investment?
- Energy losses in electricity grids are usually the result of insufficient investment required to upgrade them and implement optimal **power allocation**.

The urgent need of the electrical network is the **automation of energy distribution**, thanks to which it is possible to quickly distribute flows and avoid excessive load in the **distribution network**. The lowest level of losses during the transmission of current from the **power plant** to the final consumer is observed in those countries that make significant investments in new cable networks and **electrical distribution** nodes, which are able to respond quickly to constant changes in flows. The table shows the dynamics of changes in losses in different countries:

| Country | 2000 year | 2012 year |
|---|---|---|
| European Union | 7,19 | 6,29 |
| USA | 6,42 | 6,4 |
| China | 6,19 | 5,81 |
| Australia | 7,14 | 5,07 |

The biggest winners are those countries that use underground cable networks and combine different **types of electrical distribution system**. There is also an urgent need to adapt old and new **power plants** to local **electrical distribution** units, which provides a minimum of losses during the transmission of electricity.

#### Distribution network in Ukraine

The Ukrainian electricity system is one of the most powerful in Europe. The main share of energy is produced by thermal (45.7%) and nuclear (48.6%) **power plants**. The main problem is the aging of equipment, through which the **distribution of capacity**. Most **distribution networks** have worked two to three times longer than the standard service life. This leads to an increase in the level of losses during the transmission of energy within the **electrical distribution system** and the occurrence of a significant number of emergencies.

There is a problem of modernization taking into account the achievements of modern technology. The introduction of **distributed energy systems** with flexible relationships between different suppliers and consumers is important. A typical **distribution network** should be managed using high-speed communication channels capable of transmitting large amounts of information. One of the directions can be considered the introduction of a system of flexible energy transmission, **power distribution** and ensuring quality standards of electricity in order to integrate into the distribution systems of the European electricity market.