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Application of electrical engineering in electric power system

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Abstract. Electric power industry is the most important basic energy industry in the development of national economy, the basic industry related to the national economy and people's livelihood, and the priority development focus in the economic development strategy of all countries in the world. As an advanced productive force and basic industry, the electric power industry plays an important role in promoting the development of national economy and social progress, which is inseparable from the application of electrical engineering technology and its automation. This paper mainly discusses the application of electrical engineering technology in power generation, protection, detection and other aspects.

Keywords: Electrical engineering, power system, application, storage technology, improvement

1. Power failure case analysis

In a city's power system, a high-voltage transmission line suddenly occurred power failure. After a preliminary investigation, it was found that multiple power supply points connected by the transmission line could not supply power normally, leading to a wide range of power outages. The reason may be that wet weather causes insulator string flow, and the humid environment may lead to insulator string flow, destroying the normal insulation effect, making the current bypass the insulator, and cause a short circuit. Bird strike caused by insulator string flow: Birds may short-circuit wires on both sides of the transmission line due to insulator string flow. Equipment failure due to external interference: nearby construction sites, tall buildings may have construction operations or accidents resulting to external interference and failure.

2. Basic application of electrical engineering

2.1. Power generation

Traditional thermal power, hydroelectric power generation, and emerging wind power, solar power, nuclear power generation, are inseparable from the application of electrical engineering technology. In particular, for solar power generation, electrical engineering technology can improve the photoelectric conversion efficiency and reduce the cost through the improvement of solar cells. For wind power generation, electrical engineering technology can optimize the operation of wind turbines and improve the efficiency of power generation.

Transmission: Ensure the stability and efficiency of transmission through the transportation of the power system. In this process, electrical engineering technology can be used to optimize the design

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and operation of transmission lines, such as by adopting new transmission line materials and designs to improve transmission capacity and stability.

2.2. Substation

use electromagnetic induction to make the power configuration reach 220v standard, to ensure the smooth transformation and distribution of electric energy in different voltage levels. This requires electrical engineering technology to design and optimize transformers and other transformer equipment to achieve efficient and stable power conversion. Transformers are usually composed of windings, magnetic cores, and insulating materials. The windings are used to transmit electricity, the cores are used to generate magnetic fields, and the insulation is used to isolate parts at different potentials.

3. Technical application of electrical engineering technology

3.1. Protection

(1) Differential protection device: by detecting the difference between the inlet and outgoing current, if the preset threshold is exceeded, the protection action will be triggered. Widely used with power plants, electric motors. In power plants, differential protection is used to protect the stator and rotor windings of the generator. In the substation, the differential protection is used to protect the winding of the transformer. In the industrial field, differential protection is used to protect electric motors and other equipment. This protection device can effectively prevent the failure and abnormality of the power system.

(2) Over-current protection device: used to detect the abnormal current in the power system, including short circuit fault and overload situation. It can select the appropriate protection action according to the fault current level and duration. If the current exceeds the rating or lasts for too long, the overcurrent protection device will signal the operation of the protection equipment such as the circuit breaker to protect the safe operation of the power equipment and the system.

(3) Frequency protection device: the frequency protection device is used to monitor the frequency of the power system. An abnormal frequency may mean an unstable operation or a failure of the power system. The frequency protection device can monitor the frequency in real time. Once the frequency exceeds the set range, the corresponding protection measures, such as cutting off the power supply or adjusting the system load, are triggered to protect the stable operation of the equipment and the system.

3.2. Storage

(1) Battery storage: such as lead battery, lithium battery, sodium-sulfur battery, etc. Widely used in new energy vehicles, commercial energy storage and power grid energy storage. With the popularization and development of electric vehicles, battery storage technology is also progressing, requiring further breakthroughs in energy density and service life.

(2) Energy storage technology: including compressed air energy storage (CAES) and liquid flow battery technology, etc. Compressed air storage generates electricity by storing air in underground gas storage and expanding to drive turbines when needed. Flow battery technology uses solutions to store electricity and release energy through electrochemical reactions when needed. These technologies are characterized by high safety, low cost, high capacity and high efficiency.

(3) Power energy storage: the use of mechanical energy storage of energy technology. Typical power energy storage technologies include flywheel energy storage and compressed air energy storage technology. Flywheel energy storage works by storing mechanical energy in rotating flywheels and releasing energy by driving a generator when needed. Compressed air energy storage uses compressed air to store mechanical energy and generate energy by expanding the generator when needed. These technologies are of great significance for balancing the load of the power system and improving the

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power quality. For example, the hybrid RTG collects the energy released by the crane down into the container, converts it into electricity, and then supplies it back to the crane when needed.

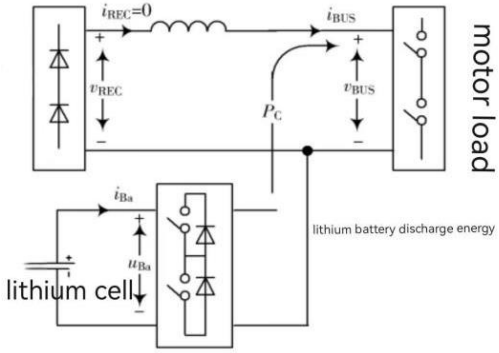

Figure1. Lithium battery pack energy storage mode

3.3. Power generation

(1) Light energy: Photovoltaic cells are usually made of multiple silicon or other semiconductor materials. When sunlight shines on the photovoltaic cells, the photons interact with the electrons in the semiconductor material to form a current current. Solar power is mostly used in areas with sufficient sunshine, which causes less pollution and easier to control than thermal power generation.

(2) Wind power generation: the process of using wind power to convert wind energy into electric energy. In a wind farm, when a large wind turbine (wind turbine) turns, its generator convermechanical energy into electricity. Wind power generation can be installed at sea or on land. Wind farms with high wind speeds are the most ideal power generation sites. These wind power technologies are maturing and becoming an important renewable energy source.

(3) Biomass power generation: the process of using biomass (such as crop straw, wood, food waste, etc.) to burn or gasification to generate heat energy and then use heat energy to drive steam turbine power generation biomass power generation can solve the biomass waste The problem is a renewable power supply, but biomass power plants are more expensive and more expensive.

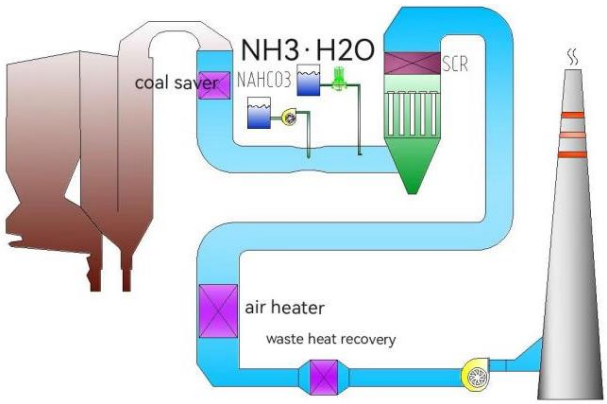

Figure 2. The principle of biomass energy power generation

(4) Geothermal energy power generation: the process of using geothermal energy to convert thermal energy into electric energy geothermal energy power generation system by drilling or mining underground heat energy to produce steam and then using steam to drive a turbine to generate electricity as shown in the figure below geothermal energy is a clean renewable energy and is of great significance to reduce carbon emissions.

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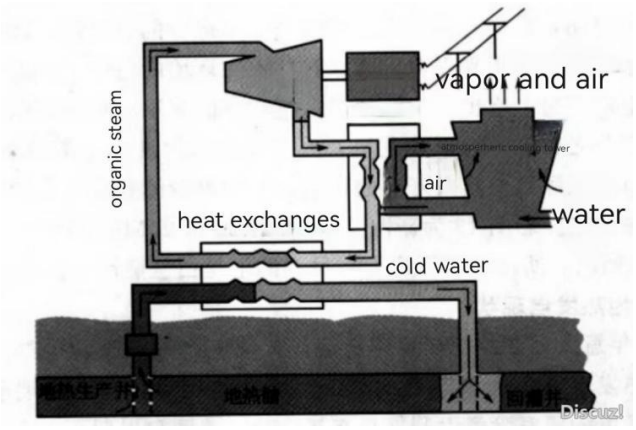

Figure 3. Principle of geothermal energy power generation

4. Optimization of the electric power system

(1) Intelligent metering system: Intelligent electric energy meter is a new type of electric energy meter with remote communication function. It can not only measure the electric energy used by users, but also monitor and record the running state of the electric power system in real time, and transmit the data to the main station for remote monitoring and analysis. Through the smart electricity meter, users can more accurately understand their own electricity consumption situation, and can also help the power supply company to better grasp the operating state of the power system, and find and solve faults in time.

(2) Intelligent distribution system: Intelligent distribution system refers to the use of advanced sensors, communication and computer technology to monitor and manage the operation status of the distribution network in real time, so as to realize the automation, intelligence and high efficiency of the distribution network. Through the intelligent distribution system, power supply companies can more accurately grasp the operation status of the distribution network, find and solve faults in time, and improve the reliability and stability of power supply.

(3) Intelligent dispatching system: Intelligent dispatching system refers to the use of advanced computer and communication technology to monitor and manage the operation state of the power system in real time, so as to realize the automation, intelligence and high efficiency of the power system. Through the intelligent dispatching system, the power supply company can more accurately grasp the operation state of the power system, find and solve the faults in time, and improve the stability and reliability of the power system.

(4) Big data analysis: it is divided into data access layer, data storage layer, public service layer, business model layer and business application layer. At the system application level, for different types of monitoring and operation services, the system applies the big data causal analysis technology to build the business big data analysis model. By defining the contents of the model, the data input type, data input mode, model calculation process and model call interval to complete the practical application of each analysis business. Up to now, the research and application of big data analysis system for monitoring and operation is still in its infancy. Big data is a technology, but also one There are three platforms to improve the management level of the industry, but we still need to strengthen the comprehensive data management, constantly refine the rules, deepen the application increase and value service, and promote the full-dimensional application of big data in the power grid operation and management.

(5) PLC technology: PLC technology has a wide range of applications and technical fields, and its core is the control technology. The PLC control technology includes four parts: the memory input and output port of the CPU, the power supply, and the storage media. These four parts are combined to realize the control technology of PLC technology. The CPU can be adjusted and expanded according to the system, respond to various external devices, and receive and analyze various instructions. The

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power supply mainly provides switching and closing functions for the entire control system to ensure full operation. The entry end is a connection terminal for external assets that can effectively communicate and exchange information both internally and externally. Storage media works like a service, providing faster and more accurate data.

5. Conclusion

Electrical engineering technology and its automation have a wide application prospect in the power system, it can improve the operation efficiency and safety of the power system, reduce the cost, promote the development of renewable energy, and improve the sustainable development capacity of the power industry. With the continuous progress of science and technology and the continuous expansion of the application scope, electrical engineering technology and its automation will play a more important role in the future electric power industry.

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