Daily Maintenance and Troubleshooting of Wind Turbines

A growing number of laws and regulations around the world encourage the use of renewable energy sources such as wind and solar power. Wind turbines usually operate in places with harsh environments, and daily inspection and maintenance must be done. Therefore, TorcStark summarizes the common faults and treatment methods of wind turbines. The details are as follows.

1. Common faults and diagnostic methods for daily maintenance of wind turbines

1.1 Main control system

As one of the core components of the wind turbine, the main control system mainly controls the normal and stable operation of the wind turbine by sending logical judgments and action commands. After in-depth investigation and research, it is found that the most common wind turbine control system is

mainly based on PLC modular design and backplane bus connection. Although the application of this control method provides strong technical support for the efficient operation of wind turbines. However, due to the actual application of this control method, various failures often occur in electronic devices due to the influence of external factors. For example, the digital or analog signal input and output of the module itself are abnormal, and the module indicator light is off. To deal with such failures, maintenance personnel mainly adopt the method of refreshing the program or directly replacing components. In addition, for the diagnosis and maintenance of external faults that occur during the operation of wind turbines, maintenance personnel mainly use the alarm prompts issued by the background monitoring SCADA system to quickly determine the fault location of external devices, and then take corresponding measures.

1.2 Gearbox

The gearbox is one of the important components of the doubly-fed wind turbine transmission chain, and it mainly plays an important role in connecting the main shaft and the generator. When the maintenance personnel overhauls the gearbox on a daily basis. Not only should we pay full attention to the inspection of the sealing of various parts of the gearbox pipeline, end cover, center hole, cooler, etc., but we should also carefully observe whether there is oil leakage or damage in the gearbox. Regularly open the observation hole of the gearbox or use tools such as an endoscope to check the flow rate of the

oil injection pipe of the gearbox and the size of the fuel injection volume, so as to avoid affecting the normal and stable operation of the wind turbine due to a failure of the gearbox.

1.3 Pitch system

The pitch system is not only the most important actuator of the wind turbine but also a key factor affecting the speed control efficiency of the wind turbine system and the utilization rate of wind energy. As a rotating component, the pitch system imposes strict requirements on the torque of the bolts and devices in the hub and the tightness of the connections. TorcStark has conducted meticulous research on the connection fastness of such equipment and has launched a special hydraulic wrench and tensioner for the wind power industry. Thereby, the probability of failure of the pitch system due to the substandard tightness of the bolt connection can be reduced. In order to ensure the normal and stable operation of wind turbines, maintenance personnel must strictly follow the requirements to check the internal components of the pitch system hub during the daily maintenance process.

1.4 Generator

As an indispensable core component of wind turbines, generators mainly play an important role in converting rotating mechanical energy into electrical energy and continuously supplying electrical resources to the electrical

system. With the continuous increase of the installed capacity of wind turbines around the world, the size of wind turbine generators is also increasing. These problems have increased the difficulty of sealing and protecting generators to a certain extent. Due to the continuous operation of the generator under different working conditions or electromagnetic conditions, there will be problems such as excessive vibration of the generator, heating of the bearing, fracture of the rotor rod, and damage to the insulation. Therefore, strengthening the daily inspection and maintenance of generators, and timely discovering and solving problems in the operation of generators will greatly promote the improvement of the operating efficiency of wind power generators.

1.5 Blades

Blades are the key components for absorbing wind energy in wind power generation systems. Generally, blades are made of fiber-reinforced composite materials. The detection of blades by wind power enterprises is mainly to accurately determine whether there is a problem with the blades by analyzing the stress change failure mode of the material in different stress environments and using infrared imaging detection equipment. Due to problems such as cracks and peeling on the surface of the blade, the distribution of thermal radiation energy will be affected. Therefore, with the help of the infrared imaging detection method, the staff can accurately detect and analyze the cracks on the surface of parts and components, and can timely find the faults

of the blades during the operation of the wind turbine. Then take active and effective measures for maintenance to ensure that the safe and stable operation of wind turbines will not be affected. In addition, if the surface of the blade is found to be detached during the inspection, the staff should first use glue to fix the detached part, and after confirming that the bond is firm, polish the blade to make it consistent with the original blade shape.

2. Troubleshooting of wind turbines

2.1 Selection of acquisition system and software design

The data acquisition system mainly converts the signals of various sensors into acceptable signals through A/D and sends the signals back to the data storage module. Acquisition boards have different working modes, and tour acquisition and synchronous acquisition are two commonly used ones. The former means that the acquisition card follows the corresponding rules and collects signals from various channels in a targeted manner. The latter means that the acquisition card collects signals simultaneously through multiple channels. In practical applications, the monitoring of wind turbines can be better completed by adopting the method of synchronous acquisition. In terms of implementing the design software, the key components of the system’s

software modules are fault diagnosis modules, signal preprocessing modules, feature extraction modules, and auxiliary function modules.

2.2 Important aspects of wind turbine fault diagnosis

Wind turbines are usually located in an environment with strong winds, generally in harsh areas such as wilderness and islands. The load generated by the wind has irregular characteristics, and it will have a strong impact on the wind turbine in the transient state, which will cause the wind turbine to fail. At present, the maximum speed of wind turbines can be as high as 1500 revolutions per minute. During long-term high-speed operation, the gearbox will experience high temperature and heat, and at the same time, under the action of load, the gearbox will fail. At present, the common faults of gearboxes include local faults and distributed faults. Local faults include gear damage, bending fatigue, etc., and distributed faults are divided into tooth surface wear, bearing damage, etc.

The types of failures that occur include the following:

2.2.1 Broken teeth

After the gear is subjected to periodic stress, cracks will appear at the root, and after a long-term load, the gear will break teeth.

2.2.2 Gear tooth surface fatigue

When the gearbox is in motion, it is affected by mechanical mechanics, and the force generated will cause the gears to appear in a state of relative sliding, but pitting, destructive pitting, and surface crushing occur on the tooth surface. The fatigued state of the tooth surface of the gear appears, and the fault state is manifested by the meshing frequency of the vibration signal, the increase of the vibration energy, and the increase of the energy amplitude.

2.2.3 Tooth surface gluing

After the gear is subjected to high speed and heavy load, the gearbox is in a high-temperature state. At this time, the tooth surface is affected by high temperature and pressure, which will cause wear on the tooth surface, and in the state of relative sliding of the gears, the tooth surface cannot be sufficiently lubricated, resulting in gluing failure on the tooth surface.

Generator failures can be divided into stator winding failures and bearing failures.

When a stator winding fault occurs, the winding is damaged, worn, and cracked, and the winding cannot provide insulation at this time.

When a bearing fault occurs, different parts of the fault will produce different vibration signals. Taking rotor misalignment as an example, such problems will be classified as eccentric faults.

In addition, the rotor and the stator are supported by bearings, and the bearings will bear a large radial load, and under the action of a large load, the bearings will fail.

Under normal circumstances, the inner and outer rings of the bearing will be damaged, pitted, and worn, and the probability of failure will increase when the bearing is in a vibrating state.