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Wind energy generation systems - Technical specification for the yaw system of wind turbines

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5.1 General Technical Requirements

5.1.1 The yaw system shall consist of a yaw bearing, a yaw reducer, a yaw brake, a yaw motor (or hydraulic motor), and a yaw control circuit. composition.

5.1.2 When the wind direction deviation of the wind turbine generator exceeds the set value for a certain period of time during operation, the control system should issue a yaw command and adjust the turbine in real time. The cabin position is adjusted to yaw against the wind. When the wind direction deviation is less than the yaw stop error setting value, the brakes should be applied to stop the yaw and the cabin should be locked.

5.1.3 The yaw system should, based on data collected by the nacelle position sensors, adjust its position when the wind turbine tower cable becomes entangled at a certain angle. At that time, the yaw motor is controlled to perform a safe cable release.

5.1.4 When the generator speed loses control or constraint from the main control system, causing the wind turbine speed to exceed the protection threshold, the yaw system executes a 90° crosswind. Alternatively, operate with the wind at your back and reduce the rotor speed to within the normal range as much as possible.

5.1.5 When the yaw system rotates in both directions, it should be uniform and stable, without abnormal noise or vibration.

5.1.6 The acceleration and speed capabilities of the yaw system shall meet the design requirements of the wind turbine generator set.

5.1.7 The yaw system design shall meet the requirements of GB/T 18451.1.It shall comply with the overall aircraft safety requirements, lifespan design requirements, and installation and maintenance requirements. Require.

5.1.8 Under typhoon conditions, it is advisable to actively yaw towards or away from the wind to reduce the overall load on the aircraft.

5.1.9 Yaw wind speed, wind direction, and nacelle position should be detected separately using an anemometer, wind direction sensor, and position sensor. Sensor selection... The type should meet the operating environment requirements of wind turbine generator sets.

5.1.10 The wind vane should be designed with redundancy and use two measurement methods.

5.1.11 The impact of cumulative error on yaw torsion cable encoders should be assessed and calibrated periodically.

5.2 Control System Design Requirements

5.2.1 When the torsion cable limit safety chain is activated due to yaw rotation, yaw should be stopped.

5.2.2 It should have a manual yaw function, and the cabin position of the yaw system should be adjusted through a human-machine interface, computer software, or portable

device. Section, parameter settings, calibration, and status information reading. Manual operation mode should have higher priority than other control modes.

5.2.3 The yaw control system design should meet the requirements of the overall aircraft load simulation. The yaw system should respond promptly to wind and meet the overall aircraft design requirements. Require.

5.2.4 It should have comprehensive protection functions, and the control system should be able to identify faults under conditions such as yaw motor overload, overspeed, and yaw slip. Activate the protection mechanism.

5.2.5 For sites with variable wind direction, relevant strategies should be adopted to improve the stability of the yaw system against the wind.

5.2.6 When not yawing, the yaw position signal should be kept stable.

5.2.7 Yaw control should assess the impact of static errors in wind direction measurement and blind spots.

5.2.8 The yaw control loop should be able to reliably control the forward and reverse rotation of the yaw motor to achieve left and right yaw. The yaw control system should have left and right yaw capabilities. Flight interlock function.

5.2.9 The yaw electrical circuit shall have overload protection and short-circuit protection functions.

5.2.10 The safety chain of the wind turbine generator set should be able to reasonably restrain yaw movements. It should also be able to provide safety protection in emergency stops, controller watchdog timers, and cable torsion situations. The chain node should stop yawing.

5.2.11 When yawing, the safety of the equipment under the operating conditions of the wind turbine generator must be considered. The wind turbine generator control strategy should meet the yaw requirements. When untying cables is required, the safety of the wind turbine generator equipment should be protected to the greatest extent possible.

5.2.12 The basic requirements for permissible yaw in the wind are that the yaw system and hydraulic system (if there is a yaw hydraulic brake) are functioning normally, the anemometer is functioning normally, and the wind force is... The generator set is not in maintenance mode, the yaw safety chain is normal, and the wind direction deviation should be greater than the yaw error setting value.

5.2.13 The basic requirement for allowing yaw untying is that the wind turbine generator is in a stopped state, and the yaw system and hydraulic system (if there is a yaw hydraulic system) are functioning properly. Brakes are normal, yaw safety chain is normal, and cabin position should be greater than the release line setting value.

5.2.14 Other basic requirements for yaw control include that the yaw system and hydraulic

system (if a yaw hydraulic brake is present) are functioning properly, and the wind turbine is operating normally. When the unit is in a shutdown or maintenance state, it should have yaw commands via maintenance handle, local monitoring panel, or central monitoring remote yaw commands.

5.3 Mechanical Design Requirements

5.3.1 The yaw system design shall be tested and verified to meet the overall functional requirements of the machine.

5.3.2 When verifying the design of the yaw drive, its operating time should not be less than 10% of the total machine operating time, but its operating time percentage should be less than 10%. Then, control simulation or test statistics with wind field data should be performed for verification.

5.3.3 If the yaw motor starts using a direct start method, the impact of the starting shock on the transmission structure must be considered.

5.3.4 The yaw motor should preferably be driven by a soft starter or a yaw frequency converter. If direct starting is used, the yaw motor should be driven by... The torque limit should not exceed the strength requirements of the transmission components.

5.3.5 Yaw braking should be achieved by the yaw motor's holding brake and the yaw brake device working together.

5.3.6 The braking torque of the yaw system should take into account the influence of the change in the friction coefficient of the brake pads on the braking torque.

5.3.7 When designing a yaw braking system, the response time of the hydraulic system and the influence of external wind loads should be taken into account.

5.3.8 When designing and verifying a yaw reducer, the uneven load during operation and the influence of frame stiffness on gear meshing should be evaluated.

5.3.9 For extreme operating conditions that exceed the design capacity of yaw drive or braking, the safety of the transmission structure under such conditions should be analyzed.

5.3.10 Wind load fluctuations can cause yaw torque oscillations, resulting in the nacelle oscillating back and forth around the tower. To reduce the impact of alternating stress on the yaw torque... To mitigate the risk of damage from the gear teeth, a certain amount of yaw damping should be designed. The yaw damping torque can be generated by the inherent friction of the yaw bearing and the load. Damping torque or damping applied by the yaw braking system.

5.3.11 The yaw system shall have a device for collecting waste lubricating grease from the yaw gears and yaw bearings.