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Wind energy generation systems - Technical specification for wind turbine braking systems

风能发电系统 风力发电机组制动系统技术规范

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5.1.1 Control System Design Requirements

5.1.1.1 The design of the braking system shall comply with the working load requirements in Table 2 of GB/T 18451.1-2022.

5.1.1.2 The braking system shall be equipped with at least two independent braking devices, typically consisting of a pneumatic braking device and a mechanical braking device. The system is complete, with the pneumatic braking device serving as the primary braking stage and the mechanical braking device as the secondary braking stage. Each braking stage can operate independently or be used during engagement. Coordinate actions in terms of timing or entry speed.

5.1.1.3 The braking system should be equipped with at least one wind turbine locking device, which should be located close to the hub. If this cannot be achieved, a portable locking device should be provided. The wind turbine locking device can be installed at any time when needed. Even when the mechanical braking device is in the open state during wind turbine locking, it still reliably ensures the wind turbine's stability. It does not rotate.

5.1.1.4 During the braking process from the operating state to the shutdown of the wind turbine generator set, the first-level brake should be engaged first to decelerate the wind turbine. When the brake disc rotates... Secondary braking can be engaged after the following limiting conditions (including but not limited to) are met.

---Maximum braking temperature limit. To prevent brake fade and failure caused by excessively high temperatures in the friction pairs, a maximum braking temperature limit should be set. Thermal balance calculation and verification at high speeds; when the brake pads are made of organic composite materials, the braking temperature of the friction pair is usually controlled at... Below.200°C (instantaneous value not exceeding 250°C); when the brake pads are made of sintered metal material, the braking temperature of the friction pair is usually... Keep it below 650°C (instantaneous value not higher than 900°C).

---Limitation of Braking Spark Stream. To avoid the risk of fire caused by continuous spark streams generated by the friction pair, spark testing should be performed at the target braking speed. Beam verification.

5.1.1.5 The braking system shall have fail-safe protection functionality. In the event of a major fault, the braking system shall be able to bring the wind turbine generator to a safe braking position. Dynamic state.

5.1.1.6 The braking system shall be designed with different operating modes, including at least normal braking, rapid braking, emergency braking, and... The wind turbine locking method should be specified, along with the conditions for engaging various operating modes and the sequence for engaging the braking devices; the emergency braking method should have a high efficiency. Priority should be shifted from normal braking to emergency braking, and even during normal braking, it can transition to emergency stop as needed. model.

5.1.1.7 The braking system shall adopt a redundant control method, and shall be designed with at least normal control logic and safety control logic, and various control methods shall be specified. The triggering conditions for control logic; the priority level of security control logic should be higher than that of normal control logic.

5.1.1.8 The braking system shall have both manual operation mode and automatic control mode. These two operation modes shall be independent of each other. Manual operation shall have... Priority is set, and the operating mode can be switched at any time as needed; different operating modes cannot be activated simultaneously under any conditions.

5.1.1.9 The braking system shall have a complete system self-protection function, and the system shall be able to protect itself in the event of overcurrent, overheating and overpressure.

5.1.2 Other design requirements

5.1.2.1 The rated static braking torque of the braking system should be greater than the minimum static braking torque required by the wind turbine generator set. The braking torque should be determined based on extreme operating conditions. The rated dynamic braking torque of the braking system should be greater than the minimum dynamic braking torque required by the wind turbine generator set. The dynamic braking torque is less than the maximum allowable braking torque of the wind turbine generator set.

5.1.2.2 The high-strength fasteners used in the braking system and its components shall meet the requirements of GB/T 33628.

5.1.2.3 The selection and design of the drive unit of the braking system should facilitate the automatic control function of the wind turbine generator braking system.

5.1.2.4 Important components of the braking system should adopt a safety redundancy design; a single component failure should not trigger a failure in more than one braking device. This can lead to a breakdown in security features, resulting in the loss of the entire security function.

5.1.2.5 The braking speed and acceleration capabilities of the pneumatic braking device shall meet the requirements of normal braking, rapid braking and emergency braking.

5.1.2.6 All sensor signals of the braking system can be obtained by the control system.

5.2 Functional and Performance Requirements

5.2.1 Manual braking function In manual control mode, the system should be able to read system status information and perform parameter settings and calibrations. In manual control mode, it should be able to perform air braking and mechanical braking operations respectively, so as to decelerate and stop the wind turbine and maintain the stopped state. In manual control mode, if a system failure occurs, the braking system should be able to keep the wind turbine shaft or wind turbine in its original position until the failure is resolved.

5.2.2 Automatic braking function In automatic control mode, the braking system should be able to accept commands from the control system to brake.

5.2.3 Normal braking function Normal braking should ensure a smooth transition of the wind turbine generator to a shutdown state. The braking force should be applied gradually to avoid damage during the braking process. The equipment caused damage. Normal braking should be able to be activated by control function commands, manual operation commands, and fail-safe function commands. When normal braking is activated, the

pneumatic braking device brakes at normal speed. Under safe conditions for the unit, the mechanical braking device may not be engaged. brake.

5.2.4 Rapid braking function Rapid braking should ensure that the wind turbine generator can transition to a shutdown state quickly and controllably, and avoid damage to the equipment due to excessive speed. Rapid braking should be able to be activated by manual operation commands and fail-safe commands. When rapid braking is activated, the pneumatic braking device applies rapid braking, while the mechanical braking device may not be involved in braking if the unit is safe.

5.2.7 Failure Protection Function

5.2.7.1 High and Low Temperature Protection. When the internal temperature of the braking system is too low/high, the braking system should be able to automatically brake to keep the wind turbine generator set in a safe position. Safe braking state.

5.2.7.2 Backup Power Supply Failure. When the voltage, temperature, or capacity of the backup power supply to the braking system exceeds limits, the braking system may still fail to function properly. The wind turbine generator is in a safe braking state.

5.2.7.3 Watchdog Failure. After a watchdog failure is triggered, the system should be able to brake normally, bringing the wind turbine generator set into a safe braking state.

5.2.7.4 Lightning protection fault. The surge protection device in the power supply circuit should be able to brake normally in case of a fault, so that the wind turbine generator set is in a safe braking state. The driver failure is as follows (5.2.7.10).

a) In the event of a motor failure in a hydraulically driven braking system, the system should be able to implement rapid braking via an accumulator to bring the wind turbine generator to a safe braking position. Dynamic state.

b) In the event of a motor failure in the electromagnetically driven braking system, all blades should be able to feather to the braking position, or the faulty blade should engage the brake, and the other blades should engage the brake. The propeller blades should be feathered to the braking position to put the wind turbine generator in a safe braking state.

c) If one blade of the variable pitch turbine jams, the other blades and the mechanical braking device should be able to apply emergency braking to ensure the wind turbine generator is in a safe condition. Braking state.

d) If one tip spoiler of a fixed-pitch wind turbine becomes stuck, the other tip spoilers and mechanical braking devices should be able to apply emergency braking to allow the wind turbine to generate electricity. The unit is in a safe braking state.

e) In the event of a mechanical braking device failure, the variable pitch wind turbine should be able to idle using air braking. Status; In the event of a fault in a constant pitch wind turbine generator, if one brake fails to operate, the other brake can work in conjunction with