Maintenance Guidelines for Wind Power Equipment

A wind power system is composed of one or more wind turbines combined with other electrical and mechanical hardware to capture kinetic energy provided by wind. These systems can vary in size and may include multiple wind turbines, but generally the same operational and maintenance practices apply.

Wind turbines are comprised of many systems that require routine regular maintenance. Properly maintaining this equipment can help to extend the life expectancy and prevent breakdowns from occurring. The following information details common wind power system safeguards and controls along with general maintenance guidance based on industry best practices.

Inspection and maintenance activities should be performed by qualified technicians following manufacturer recommended procedures and all applicable safety practices.

Controls and Safeguards

The following controls, protective devices, and features should be tested and re-calibrated at the frequency specified by the manufacturer or annually if unspecified:

Operating Controls:

- Anemometers to measure wind speed.
- Wind vane to monitor wind direction.
- Yaw control to keep the nacelle from yawing during high variable winds.
- Pitch control to keep blades rotating within the optimal speed range.
- Parking brake to keep nacelle from yawing when the wind turbine is shut down.
- Shutdown system to bring a controlled stop to the wind turbine by operating the pitch and yaw controls in conjunction with the braking system.

Safety and Protective Devices:

- Overspeed governor to initiate a shutdown when speed becomes excessive.
- Emergency manual shutdown.
- Vibration monitoring system installed to shut down the wind turbine on excessive vibration of the propeller, support tower, speed increaser gear set, and motor shafting.
- Pressure relief devices installed on the lubrication oil and hydraulic fluid systems.
- Lubrication oil and hydraulic fluid low pressure detection that will shut down the wind turbine in controlled sequence.

Electrical:

- Surge protection on microprocessor run controllers.
- Induction generators should have the following electrical protection:
  - A generator circuit breaker of the draw out type or a motor contactor of corresponding size equivalent to the induction motor rating.
  - Overload protection consisting of replica thermal devices that will open a contactor or trip the generator's circuit breaker.
  - Ground fault relay that trips a circuit breaker or opens a contactor.
  - Unbalance phase protection using a solid-state negative sequence voltage relay.

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> Surge protection consisting of surge capacitors and surge arrestors in parallel.

Preventive and Predictive Maintenance Guidelines

Due to the overall complexity and various accessibility concerns presented by this type of equipment, a maintenance contract with the equipment manufacturer or licensed service contractor is advised. The following maintenance activities should be performed as specified by the equipment manufacturer and documented in the maintenance program:

- Weekly visual running inspection.
- Annual circuit function test of overspeed trip and shutdown features.
- Annual calibration and inspection of all installed controls and safety devices.
- Annual test of the emergency stop system.
- Annual inspection of the shaft brake and parking brake.
- Annual internal inspection of the enclosed gear set.
- Annual inspection of the lubrication oil system pump, motor, relief valve, and coolers.
- Annual inspection of the pitch hydraulic cylinder, linkages, and control mechanisms.
- Annual inspection of the yaw gears, yaw motors, and yaw control system.
- Annual inspection of the hydraulic pump, drive motor, pressure relief valve, and coolers.
- Periodic bolt torqueing as required by the equipment manufacturer or service manual.
- Periodic overhaul of each of the main mechanical and electrical systems and components as arranged by the equipment manufacturer or service manual.
- Annual inspection and insulation resistance testing of the main and secondary generators.
- If the wind turbine set includes a gearbox, routine sampling and analysis of the lubricating oil should be completed. Additionally, continuous oil analysis equipment may be installed to monitor the oil condition.