White Paper

Ultracapacitors in Wind Turbine Generators

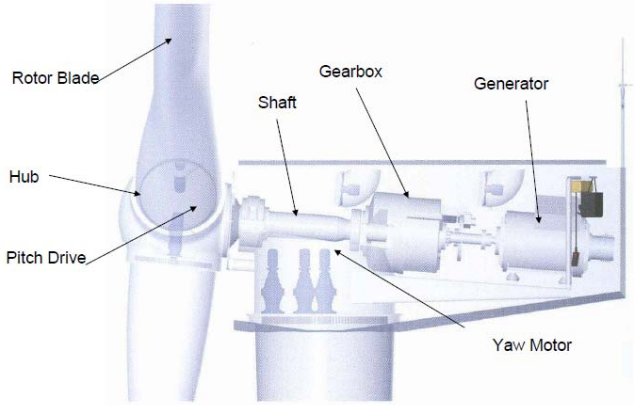
Introduction

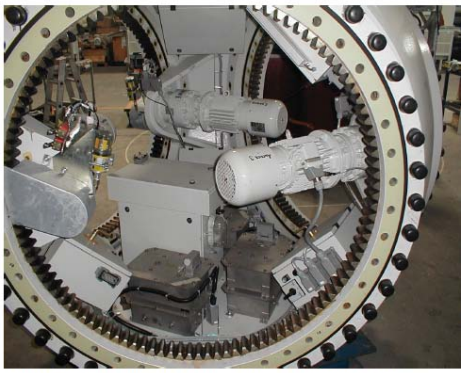
Modern wind turbines consist of three-bladed variable speed turbines that constantly monitor their own power output to provide the best quality power possible. In order to ensure such quality, pitch control systems were adapted to adjust the pitch of the blades for optimal power output.

While there are largely two types of pitch control systems, one based on hydraulics and the other based on electrical motors, the current trend is shifting toward the electro-mechanical systems due to their known reliability and low maintenance needs. To enhance the safety of turbines, the pitch control systems are also equipped with energy storage units that are used as emergency back-up power.

Ultracapacitors as back-up power source

In order to provide backup power to these pitch control systems, wind turbine manufactures use ultracapacitors as their choice for energy storage unit. Compared to batteries, ultracapacitors provide much longer lifetime and much more cycle life than batteries.

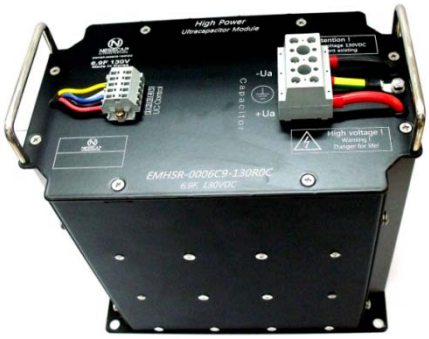




Turbine hub showing the three independent pitch systems

Compared to hydraulic system, ultracapacitors offer high reliability and long lifetimes without the worry of hydraulic fluid leakage and the maintenance associated with such possibilities. These traits are becoming even more important as wind turbines become larger and are placed in off-shore locations.

Nesscap's 2.7V360F cells, shown below, are used to create energy storage units for today's advanced wind turbines with 2MW capacity and under. These ultracapacitor modules, shown below, contain anywhere from 50 to 60 cells which are soldered onto PCBs and housed in metallic enclosures.



While the same 360F cells can be integrated for use in 3MW class and over wind turbines, the current trend has been for the use of large cylindrical cells. Nesscap's 2.7V3000F cells, shown below, are used to create the energy storage unit.

Typical wind turbine pitch control systems operate at around 300V to 400V. Corresponding numbers of ultracapacitor modules or large cylindrical cells are used to create an energy storage unit that can meet the emergency back-up energy requirements of the wind turbines.

Other applications within the wind turbine

Other wind turbine parts or sub-systems that have traditionally used hydraulic power can switch over to

an electro-mechanical system. One such system is a brake system for the wind turbines. These brakes also have back-up energy storage unit that will power the brakes in case of an emergency.