Large-scale industrial and utility-based power generation from wind are growing in deployments and economic viability. The business model for land-based wind-generated electricity is favorable compared with most other sources. As of 2013, according to the U.S. EIA, renewables made up 13% of Americas electricity sources (nuclear 19%, natural gas 27%, coal 39%, petroleum 1%). Wind made up 32% of the renewable sources (hydro 52%, biomass 12%, geothermal 3%, solar 2%). Globally, according to the Global Wind Energy Council (GWEC), in 2013, cumulative global capacity from wind was 318,137 MW, an increase of nearly 200,000 MW since 2008. Wind power growth has been moderate in the U.S. and Europe, stronger in Canada, China, India, Latin America and Africa.

The electronic controls and communication involved in wind towers and turbines can be sophisticated. Beijer Electronics produces human machine interfaces (HMIs) for original equipment manufacturers (OEMs) to help control and manage certain processes within a wind nacelle. Beijer also produces industrial networking equipment to connect devices within a wind nacelle and tower, between towers and to centralized control centers.

**Wind Nacelle Components**

Wind nacelles sit on top of wind towers and house the electrical generation components including the following:

- **Rotor** – blades mounted to a hub.
- **Pitch Drive** – ideal lift/position for the blades.
- **Yaw drive** – keeps the rotors facing into the wind.
- **Brake** – shaft control during operation and maintenance.
- **Low-Speed Shaft** – connects the rotor to the gearbox.
- **Gearbox** – converts lower-speed turbine to higher speeds required to produce electricity.
- **Coupling or High-Speed Shaft** – connects the gearbox output to the generator.
- **Generator** – converts mechanical energy created by the wind turbine into electrical (AC or DC) power.
- **Slip ring** – ensures reliable power and signal from stationary component(s) to rotating shaft or equipment.
- **Controls** – regulators for the blade pitch, nacelle yaw, intra-turbine workings such as shaft speed, blade heaters/de-icing systems, etc.
- **Power Converter, Inverter, Transformer** – depending on the design, the electrical power is transferred and converted into the AC or DC power required by the transmission and distribution system.
- **Anemometer and Wind Vane** – communicates wind speed and wind direction to the controller.
- **Lubrication System** – ensuring the gear box, shafts, pitch/yaw motors and gears are lubricated and cooled.
- **Networking and Cabling Equipment** – communication within nacelle, between towers, to the control center.
Application Note: Power Generation - WIND

Using Beijer HMIs in Wind Power Applications

HMIs provide the operator’s view and control of devices and equipment deployed within a wind nacelle. HMIs are used by wind power OEMs to control blade pitch, nacelle yaw, inverters, speed, generator performance as well as relaying information provided from sensors associated with wind speed and direction, temperatures inside/outside the nacelle and of components such as the gearbox, rotor ice build-up, and fluid levels, flows and pressures.

Beijer’s iX HMIs are advanced operator terminals that provide remote access and control. The iX HMIs can be configured to log events and activities. These logs can be pushed or pulled into standard formats for analysis, trending and long-term storage. The alarm viewer provides real-time awareness of abnormal conditions. Maintenance workers can view system and component manuals, videos and web pages for quick and accurate access to pertinent information.

Beijer’s iX operator terminals can be configured as a mini-SCADA system for the components within the wind nacelle. The operator interface terminals provide the control, data repository, and drill-down capabilities for administrators and technicians, whether they are physically within the wind tower or nacelle or connected remotely.

Wind Farm Development and Construction

Large-scale wind farm are costly in terms of time and capital. Wind energy development costs have decreased 90% since the early 1980’s. Advancements in technology have reduced wind turbine costs, increased performance, streamlined operations and maintenance, while advanced knowledge have enhanced engineering and construction abilities. The following are some key players in the development, design, manufacturing, construction and purchase of wind power that can benefit from understanding, specifying and deploying Beijer HMIs and associated components:

- Wind power developers: NextEra Energy, Great Southwestern Construction, Invenergy, E.ON, EDF Renewable, RES Americas, First Wind, Terra-Gen Power, Midwest Wind Energy
- Wind engineering firms: Tetra Tech, Black & Veatch, Burns & McDonnell, Fichtner, WSP, DNV GL, Ingham
- Turbine OEMs: GE, Vestas, Siemens, Gamesa, Suzlon, Clipper Wind, Acciona, RE Power, Nordex

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