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**Title :**

# „Planning and Interconnection Technologies of Renewable Energy Supply from Windparks to Power Grids“

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**Key Words :**

Grid Connection, Windfarms, Power Transmission, Power Distribution, Stability, Reactive Power Compensation, Voltage Control, FACTS Flexible AC Transmission systems, SVC Static Var Compensation, HVDC High Voltage Direct Current Transmission, Transmission Network Planning

**Abstract**

With the growing demand for installation of renewable energy resources wind energy becomes a more and more important issue to be smoothly integrated into the energy mix. The system characteristics of wind generation is determined by two crucial planning aspects which need carefully considered when a wind park needs to be connected to the public distribution / transmission grid. One of the two important characteristics is variable generation, both in terms of time and space (minute by minute, minimum cut out speed, wind gusts, geographical distance between turbine towers, etc..), the other issue is geographic location. Wind generation can be transported electrically over long distances– unfortunately today there is no economical storage for large bulk power available. Wind energy must therefore be transported (sometimes) from far remote locations of the wind turbines by long overhead lines/cables to the load consumption centers.

This presentation will provide an overview on the present technologies available to connect wind parks to the high voltage grids of the electrical utilities and will discuss the decisive electrical system planning aspects. System performance/security requirements of the network utilities need to be fulfilled when large bulk power wind park installations are connected. Several aspects such as capacity and transmission planning, development of generator technologies and operational procedures of the wind park will determine the final reliable & technical solutions.

From experiences of wind park planning/operation in Europe some typical transmission requirements will be addressed and technical solutions to enhance stable and reliable operation during steady state and transient system conditions will be discussed. Typical objectives are such as system security and integrity, rapid restauration after faults and disturbances, stable transmission capability over long distances, voltage control and power quality.

The key technologies AC transmission and voltage control by dynamic compensation with FACTS, SVC or STATCOM equipment will be illustrated for improving steady state and dynamic performance to recover from/after system disturbances and faults. To provide an overview on long (offshore) distance transmission, examples comparing AC- and DC transmission/cable technologies, back-to-back frequency converters for large or for small power conversion will be introduced such as GPFC Grid Power Flow Controller Technology and HVDC PLUS or small scale SIPLINK IGBT based voltage sourced inverters.

Grid code requirements for connecting wind parks are partially realized with various requirements in different countries – the presentation will include some examples for discussion used by European utilities/grid owners (leading standards by German and Danish utilities under progress).

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