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01-New features of wind power projects at present & Several key points should be focused on during projects prophase consultation

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Abstract: Several important financial income indicators can be measured and calculated through the wind power projects prophase consultation. These measured and calculated results can provide decision-making basis for investors, and define major risk control points which should be focused on by the investors during projects implementation process as well. This article, which combines the actual conditions of the wind power projects development and operation of our country, through several specific examples, analyses the three major influence on the financial income of the wind power projects, including the replacement of technical specifications, new requirements of construction standards, and variation of the market environment.

Key words: wind power project  risk  power cuts  subsidies for electricity price project income

02-Finite Element Analysis of Large Wind Turbine Tower

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Abstract: According to the theory of finite element method, the finite model of large wind turbine is built. The paper discusses the static strength analysis of tower in various loadcase. The model analysis can get the natural frequency and vibration mode. The stability analysis of tower is investigated. The results show that critical buckling load by the nonlinear buckling analysis method is rational. This paper analysis the effects of load on the buckling, as well as influence of different of the load.

Key words: Wind turbine tower  Finite element method  Static strength  Modal  Buckling
03-Research and Application of innovative management model in wind power

Zhang Mign Jie, Cong Zhi Hui
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Abstract: With the companies are growing, Chifeng Company has nine wind field, has brought many challenges to the leader in the staffing and management, in order to improve the management level, Chifeng Company especially the establishment of a centralized control center, efficient, unified management model to the management of the company has brought unprecedented convenience. For centralized control center in the actual operation of the summary and analysis, and carried out a detailed study.

Keywords: centralized monitoring; centralized control center; management system; benefit analysis

04-The strength analysis of large offshore wind turbine blade root

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Abstract: With the environment problems caused by traditional energy sources have become increasingly prominent, more and more countries all over the world are focusing on exploitation of renewable energy, especially wind energy, and offshore wind power has gradually become a new field of wind power development. In order to adapt to the development of offshore wind power, our company independently developed 6MW large offshore wind turbines. Blades as the core component of the large offshore wind turbine, the strength of connection determines the use of offshore wind turbine efficiency and operating life. Using ANSYS software parametric design language APDL, the FEA model of blade root connection is established efficiently. With high strength bolts are connecting the blade root and pitch bearing outer ring, and bolt to exert a certain amount of preload using contact nonlinear calculation in ANSYS, the static analysis and strength check of the blade root connection bolts with the combined effect of the preload and external load. In addition, the load of blade root calculating by professional software, combined with the SN curve of the material, checking the fatigue strength of blade root connecting bolts. According to this method, it can improve the efficiency of FEA modeling and shorten the design and check cycle of connecting bolts, to provide the help for blade connecting design and optimization.

Keywords: offshore wind turbine  blade root connection bolts  parametric design language  fatigue strength
05-The simulation research about the performance of double-fed induction generator under three-phase voltage imbalance

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Abstract: As national policy and related standard have been issued, dispersed wind power generation has become a new development direction of the wind power industry. At present, the existing dispersed wind power demonstration projects have put into operation. However, because there is the single-phase load imbalance of the distribution network, the larger three-phase voltage imbalance of the distribution network exists. So the dispersed wind power generator connected to distribution network is facing a very serious problem: three-phase voltage imbalance. Aiming at this problem of the distribution network, the dynamic model of doubly-fed wind power generator and three-phase voltage imbalanced simulation module have been built firstly using Digsilent software platform in this paper. The three-phase imbalance impact on the performance of doubly-fed induction generator has carried on the theory and simulation analysis, and the analysis conclusion is given.
Key words: Three-phase voltage imbalance, Double-fed induction generator, Dispersed wind power, Digsilent

06-The applied research about the power wind shear formula

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(2)WindSim China Beijing

Abstract: This thesis analysis the common method that used to calculate the target height (generally the hub height) speed in wind resource assessment, and propose an new method to use the power wind shear formula. According to the real measure data of the wind farm, the new method has been checked.
Key Words: Wind shear, Fit, Compare
07-Research of Wind Turbine Fault Statistics Analysis

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Abstract: Based on an actual running wind farm, all the wind turbines annual number of faults are counted, and combined with monthly generating capacity of the wind farm, the monthly mean wind speed and monthly mean temperature, the correlation between the number of wind turbine failure with operating conditions and ambient temperature to be explored, then the reasons for the high incidence of major system failure are analyzed. Finally, some measures to reduce wind turbine failure rate and to improve the operation and maintenance were proposed.

Key words; wind powe; wind turbine; fault; statistics analysis

08-Research on pressure calculation for pipelines of the oil cooling system of the gearbox in the wind turbine

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Abstract: Oil cooling system to run on wind turbine has an important role, as oil cooling system working conditions, especially temperature conditions of high viscosity of the oil pipeline, flow resistance, resulting in high system pressure, pump damage. Through the oil cooling system and low temperature performance and condition of the pipeline for effective resistance calculations to simulate site conditions, to better reflect the complex environment in case of product performance and avoid damage to the fan parts, downtime and other issues.

Key words: Oil cooling system, Pipeline, Low temperature performance, Pressure calculation;
09-The welding procedure qualification of welding constructure part for MW level Wind Turbine

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CSR Zhuzhou Electric Locomotive Research Institute Co., Ltd.

Abstract: In order to insure the welding quality of welding constructure part for MW level Wind Turbine, this article analyses the welding procedure qualification implement of welding constructure part for MW level Wind Turbine. It presents some programs from selecting standard and the welding procedure qualification implement. The test results show that the specifications of welding process used in implement are reasonable and they provide the basis for the establishment of welding process specifications.

Key words: MW Wind Turbine; Q345E; the welding procedure qualification

10-The Process Management in The Prototype Test for MW Wind Turbine

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Abstract: This paper introduces the key of process management in the prototype test for MW wind turbine. To ensure the prototype test smoothly, the methods of process management, such as, strengthening technical disclosure, application of virtual manufacturing in preparation for the process, drawing process network diagram, process certification, are adopted. Then production experience in process management and data storage is well done, to prepare for the batch production.

Key words: MW Wind Turbine; Prototype Test; Process Management; Process Network Diagram; Process Certification
11-A Chinese R & D Center in Germany: SANY’s Case

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ABSTRACT: This paper is an attempt to share the global strategy and the best practices and methods in developing an overseas R & D center that a Chinese company would encounter. The author has been responsible to lead and advise SANY’s board members in this effort from the initial concept. There have been many challenges and learning experiences along the way of this capacity building endeavor. The challenges facing Chinese companies including the cultural and regulatory requirements such as obtaining permits, brand recognition, staff recruitment and training, and proper operational model and metrics along with the potential technical and technology gains, the progress made and some recommendations will all be discussed.

Key Words: Western R & D Center, China Expansion Strategy, SANY

12-Exploring a Method of Improving Wind Flow Model Accuracy and Reliability
——Wind Profile Adjustment and Cross Checking of Met Mast

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Abstract: Improving wind flow model accuracy and quantifying wind flow model reliability are two major problems in the wind resource assessment field. To improve model accuracy, maximum coincidence between simulated and measured wind profiles should be achieved when using WindSim software based on CFD technology, by adjusting the surface roughness length value and atmospheric stability to change the initial condition and boundary condition of the model. In general the wind flow model have some errors, met mast cross checking can quantify vertical extrapolation (wind shear model) and Horizontal extrapolation reliability of wind flow model, providing judgment for uncertainty of wind farm power production estimation. In this paper, we take the wind power project in Hebei Province as an example, to improve wind flow model accuracy and quantify wind flow model reliability, maximum coincidence between simulated and measured wind profiles are achieved and cross checking are applied by using WindSim software based on CFD technology.

Key Words: Wind flow model, Accuracy, Reliability, WindSim, Wind profile adjustment, Cross checking, Horizontal extrapolation, Vertical extrapolation
13-The Simulation Research on the Performance of Double-fed Wind Generator System Through Dispersed Connection under Frequency Deviation

LiChen Xue, Lei Pan
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GuoDian United Power Technology Co., Ltd.

Abstract: As national policy and related standard have been issued, dispersed wind power generation has become a new development direction of the wind power industry. At present, the existing dispersed wind power demonstration projects have been put into operation. However, due to the distribution network at the end of the power grid and the start-stop of load causing a greater impact on the frequency of distribution network, the frequency deviation of the distribution network is bigger. So the higher request of frequency adaptive about dispersed wind turbines is put forward. This paper mainly focused on the frequency adaptive of dispersed double-fed wind generator system, and there are two aspects to be considered respectively: doubly-fed induction generator running high speed with low frequency and low speed with high frequency. And then the theory and simulation research of frequency impact on rotor voltage are completed. Besides, under the premises of speed range and rotor voltage, reducing the rotor open circuit voltage of generator is proposed in order to meet the requirement of frequency adaptive of distribution network.

Key words: Frequency adaptive, Double-fed induction generator, Dispersed wind power, Digsilent
14-Discussion about power limitation in wind farm and industry problem

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Abstract: According to the investigation of the power lost situation in many wind farms, this thesis collects some production data of partial wind farms and the lost production due to wind curtailment, and explains some problems such as components failure and fatigue damage, domestication, enterprise running, capacity of WTG, wind energy industry ideas and principles, pre-acceptance of WTG, guarantee end etc. It also analyses and explains the situation of wind farm, grid, the WTG owners, WTG manufacturers and components suppliers. In the same time, the author gives some opinions about the inner problem of the wind power industry to the related departments and the trade companions for reference.

Keywords: wind curtailment; wind farm; WTG manufacturer; components suppliers; grid

15-Gear Micropitting of Wind Turbine Gearbox and Its Prevention

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Abstract: Gear micropitting has been discussed since long time ago, but with the rapid development of the industry application, and the growing demand of the long life and high reliability of the gearbox, more and more attention has been sent to this micropitting phenomenon. Relevant organizations such as AGMA, NREL, etc. have conducted a series of case studies, ISO has released standard for calculation of micropitting resistance capability, and safety factor against micropitting also been added in GL 2010. Main influencing factors that affect gear micropitting are discussed in this article based on the ISO 15144-1:2010, and the corresponding methods that could be a help for reducing gear micropitting probability in wind turbine gearbox proposed.

Key words: Wind Power, Gear, Micropitting, Prevention
16-Analyze on Dynamics Characteristices of Wind Turbine Drive Train

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Abstract: In this paper, a research is done for the drive train system of a megawatt wind turbine, which is based on flexible multi-body system dynamics theory. The blade, hub, main shaft, gearbox, etc are made the flexible body, and the dynamics model of the transmission chain of the turbine is built, including the gear transmission system, to analyze the inherent characteristics of the system. All potential resonances of the turbine transmission chain between cut-in and cut-out speed must be analyzed, which are based on 2D Campbell plot and Eigen-energy plots. By time domain analysis to further identify potential resonance points of the transmission chain; according to the analysis results to verify the reliability of the turbine transmission chain design.

Key words: wind turbine; drive train; dynamic characteristics; potential resonances
17-Condition Monitoring of Rotor Blades: Damages, Ice, Overload

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Abstract: Rotor blades are among the most highly stressed components of wind turbines. And if damaged they are also one of the most expensive parts to replace. The currently executed monitoring of rotor blades by visual inspections on a period basis with long intervals in-between can be problematic, because a small and easily rectifiable defect can grow to become a serious problem. Besides damages particular environmental conditions such as icing and overloads can also influence the operational state of the rotor blades and therefore the entire wind turbine. Since these phenomena are of temporary nature they can only the detected by a continuous surveillance of the blades.

An introduction is provided to the analysis of a rotor blade’s natural frequencies as the bases of a continuously operating condition monitoring system. The blade oscillations are measured with accelerometers mounted inside the rotor blades. The analysis of the spectra is done by comparing the measured frequencies to reference data.

Severe and light damages can be securely distinguished from their appearance in the frequency spectrum. Examples show the correlation between damage and frequency deviations.

Ice formation as additional blade mass can be determined directly from the measurable frequency shift with an accuracy of up to 0.004% of the blade mass which will be shown with examples. The method measures during shutdown periods as long as wind blows, thus enabling automatic restarting of the turbine without on-site inspection after ice has shed.

Further, the experience of combined 750 operational years of rotor blade monitoring is summarized.

Key words: Condition monitoring for rotor blades of wind turbines, Damage detection for rotor blades, Ice detection on rotor blades, Analysis of natural frequencies
18- Analytical techniques for performance monitoring of modern wind turbines

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Abstract
There is strong demand in the wind industry for understanding, in great detail, the performance of operational wind farms. This can be achieved by collecting sufficient data from the standard SCADA system, the careful management of those data and the use of intelligent interrogation techniques.
Recent years have seen rapid development in wind turbine technology, with modern turbines adopting variable speed and pitch concepts and complex solid state power conversion technology. Also, increasingly intelligent controller software programs now often include self protection algorithms, noise reduction and dynamic power curtailment as standard.
In line with these developments, the analysis techniques commonly used in the industry, which were primarily developed for more basic technology in relatively small wind farms, have become outdated. Such techniques no longer reveal all of the attributes of modern wind turbine performance and are also typically difficult to implement on large wind farms in a cost effective way.
This paper describes how SCADA data from modern wind turbines can be analysed to mitigate sub-optimal performance. The paper describes which data signals tend to be the most useful and what to look for. Moreover, it describes how these signals can be monitored by an automated system to ensure that deviations from optimal performance are detected rapidly, facilitating prompt corrective action.

Keywords: Wind Turbine Performance, Optimisation, Diagnostics
19-The assessment of extreme gust wind speeds at sites which experience Tropical Cyclones

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Abstract: Increasing demand for wind energy around the world has led to wind turbine installations in tropical cyclone regions, such as the Gulf of Mexico and the western North Pacific. This includes markets in the U.S., Central America, Japan, China, Taiwan, Korea and the Philippines. Germanischer Lloyd Renewable Certification (GLRC) is presently editing a Technical Note on the design and assessment of wind turbines for tropical design conditions, including tropical cyclone classes and design load cases representing extreme wind speed and wind direction situations.

One of the major inputs to such an assessment is the review of extreme cyclonic winds. GL Garrad Hassan (GLGH) propose a joint paper with GLRC, describing new developments in the methodologies for the assessment of extreme gust wind speeds at sites which experience Tropical Cyclones.

The calculation of extreme wind conditions in such regions is generally considered to be challenging and it is noted that typical methods used to estimate extreme wind speeds may not be applicable. This is particularly important due to the relatively limited duration of pre-construction wind data measured at most wind farm sites in comparison with the design operational life. GL GH has therefore developed methodologies based on long-term typhoon track data coupled with cyclonic wind velocity profiles, to allow review of extreme wind speeds at prospective wind farm sites.

Key Words: Tropical Cyclone, Typhoon, Gust, Extreme, Wind Risk.
20-Dynamic model of frequency control in Danish power system with large scale integration of wind power

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Abstract – This work evaluates the impact of large scale integration of wind power in future power systems when 50% of load demand can be met from wind power. The focus is on active power balance control, where the main source of power imbalance is an inaccurate wind speed forecast. In this study, a Danish power system model with large scale of wind power is developed and a case study for an inaccurate wind power forecast is investigated. The goal of this work is to develop an adequate power system model that depicts relevant dynamic features of the power plants and compensates for load generation imbalances, caused by inaccurate wind speed forecast, by an appropriate control of the active power production from power plants.

21-Research on power curve of wind turbine interconnected with power grid

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Abstract: Grid wind turbine power curve is a measure of an important indicator of the level of economic and technological units. The selection of the power curve drawing method selected and the actual impact of factors amendment determine the power curve obtained in line with actual production. In this paper, it explored the power curve drawing method and the main influencing factors of wind power and other issues, and the calculation method of the power curve assurance coefficient using the numerical integration method. Combined with the actual operation of the wind farm data, using the data processing method on wind turbine output is validated. Research results indicate that the power generation calculating and data processing method proposed in this paper has high reliability and Maneuverability, timely response to wind turbine operating conditions.

Keywords: Wind turbine, Power curve, Estimation of generating capacity, Influencing factors
22-Optimization Design Method of Wind Turbine Tower Based on Strength Analysis

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Abstract: The tower is an important part of wind turbine and accounts for a large portion of the cost of wind turbine. An optimization design method of wind turbine tower was proposed relative to industry standards and work experiences in this paper. This method taken the load dates of the tower as the input is based on the ultimate analysis and fatigue analysis. The tower is optimized through a series of circular calculation to make the magnitude and distribution of security margin more reasonable. The application proved that this method is feasible, effective and meet the certification standards, it can provide a reliable scientific basis for the optimization design of tower.

Key words: Wind turbine; Tower; Optimization design; Ultimate analysis; Fatigue analysis
Abstract: The analysis of turbulent wind field associated with tropical cyclones is clearly important when designing and assessing the feasibility of wind turbines in tropical cyclone regions. With respect to the extreme wind conditions, the approaches of extreme loads analysis in the IEC 61400 standard and the GL Guideline are not for turbine in cyclones. It would be a very risky proposition to simply install an existing type of wind turbine in regions affected by tropical cyclones without taking into account the wind characteristics in the TCBL. This article presents a detailed study of the external wind conditions in the Tropical Cyclone Boundary Layer (TCBL) including physical constants, wind speed, direction, shear, turbulence intensity, turbulence length scale and turbulence spectral models. This study focuses on the wind characteristics of the cyclone eye-wall region that carries the strongest wind. For the dynamic response of wind turbine structures, it is worth the effort to characterize the size of eddies constituting turbulent wind. The turbulence integral length scale for cyclone wind is defined and validated with various measurements. Three popular spectral models (ESDU von Karman, Kaimal and Mann) are validated with measured spectra as well and the ESDU von Karman model does give the best fit. The current work has been introduced to the GH Bladed wind simulation package. The 3-dimensional stochastic cyclone wind field can be generated and used in a full time domain aeroelastic simulation. This capability can be used to compute the cyclone loading of a wind turbine in an appropriate series of load cases. The article discusses the possible load cases and presents example results.

Key words: Tropical cyclone, turbulence, loads analysis
24-Oil On-line Monitoring System of the Equipment Based on IOT

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Abstract: Aiming to meet the application demands that the production and development of a large scale of multi-MW Wind turbines require in China in recent years and to solve the problems of wind turbines which are made in China, for many entrepreneurs pay attentions on wind turbines maintenance expenses, the paper proposes oil on-line monitoring system of the equipment based on IOT and achieves functions via initiative maintenance PAP (Predict and Prevent). The technology focuses on monitoring based on the demands (mainly information transmission), information integration analysis, products full-life periodic tests, technical development and application of system maintenance optimization. Products and equipment maintenance reflects the idea of faults prevention to achieve safety in production which maximally eliminating running faults and recognizing core equipment health management in order to new energy enterprises (Wind power generation)’ urgent demands on improving production and maintenance of expensive wind turbines.

Key words: IOT, Oil on-line monitoring, status monitoring, wind turbines maintenance
25-Manufacturing Surveillance of Wind turbines as part of the Project Certification according to GL Guidelines GL2005 and GL2012

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Abstract: Today’s wind farms, especially when located offshore, are a big investment for involved stakeholders. Thus all important measures for ensuring quality should be carried out in order to protect these investments.

Improper manufacturing of components can be a root cause of later costs for repairs during operation phase. These costs will be very high due to great effort for disassembly, special equipment (cranes, ships), specialized personnel and the non-productive time of the turbine. Thus it is recommended to minimize this risk in a very early project stage while all components are accessible, easy to survey and if necessary to repair.

Minimization of this risk can be achieved with the surveillance of manufacturing by a neutral third party that can access all relevant design documents and is experienced in the assessment and inspection of wind turbines and their components.

This paper lays down the prerequisites of the Manufacturing Surveillance according to GL Guideline 2005 and 2012 and clarifies the following questions:
• Which Certificates are needed?
• Which components are subject of the manufacturing surveillance?
• Which are the advantages and benefits for investors, operators and manufacturers?
• To what extent are the components inspected?
• What is forward traceability, where and why is it required?

In addition the general process of manufacturing surveillance is described, starting from the preparation and ending with the successful assembly of the components.

This essay ends with examples from practice and points out typical challenges and risks related to manufacturing. At the same time the benefits in terms of quality and assurance for investors and owners if a neutral party is involved are outlined.

Keywords: Certification, wind farms, offshore, manufacturing, surveillance
Certification Requirements for the Drive Train Dynamics of Wind Turbines according to GL 2010 and 2012

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Abstract: The dynamic behaviour of the drive train of a wind turbine is of major importance for the evaluation of design loads for the machinery components within such devices. Multi-Body-Systems (MBS) are widely used for this task. These models are used for the identification of eigenfrequencies and the resonance behaviour of the drive train. The purpose of the analysis is the investigation of load-increasing resonances in the main drive train components. These resonance phenomena are usually not represented in the global simulation model for the determination of the design loads. The requirements for the certification of wind turbines according to Germanischer Lloyd Industrial Services GmbH, Renewables Certification (GL) are described in the Guideline for the Certification of Wind Turbines. The latest revision of this Guideline (GL 2012) was issued in December 2012.

This paper covers the requirements according to GL 2010 and GL 2012:

• Simulation
  o Different approaches (full simulation or reduced simulation supported by measurements)
  o Level of detail
  o Common problems
• Documentation requirements

Keywords: Drive Train Dynamics, certification, resonances, drive train, simulation
27-Preliminary Study on Wind Resource Research and Application for Wind Farm Full Life Cycle

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Abstract: Currently the wind resource research and application concentrates on wind assessment and yield prediction. To adapt the demand of Chinese booming wind industry it begin to provide service for many new fields, e.g. wind farm O&M, wind turbine R&D, and project postevaluation. This paper summarized and reviewed the research and application situation of all wind resource service supplier and user, then deduced a new concept of wind resource research and application for wind farm full life cycle. Finally the author tried to illustrate how the new concept put into practical application by using two examples of case study.

Key words: wind resource, life cycle, wind farm
28-Structural Safety Analysis of 2nd Generation 150 kW Wind Turbine

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Abstract: The Institute of Nuclear Energy Research (INER) developed and erected a 150 kW wind turbine, INER-P150, in 2009 and initiated the 2nd generation project, INER-P150II, in 2011. According to IEC 61400-1 safety requirements, the design criteria of INER-P150II is in the category of Class I-A. INER-P150II implements the active control systems commonly seen on the large wind turbine such as active blade pitch control, active yaw control, and main shaft brake control. The design loads in compliance with IEC 61400-1 Class I-A were obtained using computer code FAST developed by NREL (National Energy Resource Laboratory). The finite element models of critical components such as the hub, main shaft, frame, pitch mechanism and pitch driver support base, etc. were modeled using ANSYS Workbench version 14. The purpose of this report is to perform the ultimate strength analysis of critical components and to verify the safety of INER-P150II in compliance with IEC 61400-1.

Keywords: Wind Turbine, Structural Safety Analysis

29-Revolution in high power windmill converter design

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Abstract: The windmill market is still growing in China. The new connected windmill power in 2012 was higher compared to the new installed windmill power. China has the target to have 100GW cumulative connected wind power in 2015 and 200GW in 2020. This is a very tough target.

By today, mostly DFIG windmill are installed in China. The very common ones are 1.5MW (DFIG), 2 MW(DFIG) and 3MW (DFIG). For this windmill power, there are a lot of IGBT modules in the market and paralleling is not a problem. The trend is going to full size windmill converter and in this case high current is required.

Full Size windmill seems to be attractive above 1.5MW. The very common ones are 1.5MW, 2MW, 2.5MW and 3MW full size windmill converter. The leading windmill companies are using different topologies and therefore the requirements for the IGBT are different. Paralleling of IGBTs or paralleling of complete converter is possible, however, the main question is: which is the best price/performance constellation and which price is achievable? Cost pressure is getting higher and higher.

Keywords: SKiiP X, condensation allowed for IPM, compact power unit design, no thermal paste, Sinter technology
30-Fatigue Life of Wind Turbine Key Components

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Abstract: Modern megawatt class wind turbines are exposed to high and complex loads, and compared to other industries, the design life of a wind turbine is very long. So it is essential to apply fatigue analyses for those key components. On this basis, then to optimize the component’s structures and reduce the weight of the whole wind turbine.
This paper presents the approaches for fatigue analyses applied to those key components of wind turbine.

Key words: wind turbine, load, rain flow, S/N curve, material, stress hypothesis.

31- Energy-saving Conductor Material Copper Clad Aluminum Bus Bars In the Application of Wind Power Control Products

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Abstract: This paper discusses the key parameters, reliability, experimental verification of new energy-saving conductor material copper clad aluminum bus bars, conductor material performance comparison with wind power cable, aluminum busbar etc, and copper clad aluminum bus bars’ application in the wind power conductive electric rail (busway), wind power converter and wind power box-type substation etc.

Keywords: Copper clad aluminum busbar, Reliability verification, Economic benefits, Wind power conductor rail, Current transformer, busbar in cabinet
32-The Low Voltage Ride Through Key Technology Research for DFIG Wind Turbine

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Abstract: In recent years, wind power is developing rapidly as a renewable energy. Total installed capacity of wind turbines is increasing every year. The proportion of the power system is also higher and higher. The influence of the wind power characters to the stable operation of power system also gradually increases, so low voltage ride through functions of wind turbine is much important. When grid voltage dips caused by faults, wind turbines with low voltage ride through function remain connected to the grid, and support reactive power to the power grid and help the voltage recovery. On the contrary, without low voltage ride through function, wind turbines will cut out the power grid. Large-scale wind turbines cut out the grid at the same time that will make power system worse, and even causes the entire power system deterioration. So the grid company requires wind farms meet the low voltage ride through requirement in the grid code. Doubly-fed wind power generator is not isolated with the power grid. There are some difficulties to realize low voltage ride through function. For example, how to deal with the rotor large current when the power grid voltage drop, how to control the reactive power support function response time to meet the grid code, how to reduce the influence of active power recovery rate to the transmission chain, and how to deal with the over-speed of wind turbine during the voltage dip. This paper mainly researches the key technologies of the low voltage ride through of DFIG wind turbine, and tries to find the optimal solution with the simulation.

Key words: DFIG wind turbine, low voltage ride through, Crowbar, Chopper
33-How to eliminate the influence of micro-climate on the prediction accuracy of wind power forecast system

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Abstract: In recent years, developers pay more attention on wind power forecast technology. But more and more wind farms are in complex terrain and complex environment, how to eliminate the influence of micro-climate on the prediction accuracy and increase the whole forecasting accuracy becomes an urgent problem which should be solved. Micro-climate influences are from the two aspects: one is the difference between CFD simulation and real situation, the other is the difference between NWP and local complex climate. In order to eliminate the influence of micro-climate, we use two methods: adjust CFD model based on measurement of met mast; do statistical analysis based on operation data of wind farm. We use two different statistical analysis methods: one is linear statistical correction method integrated with downscaling; the other one is to apply ANN method. This research project is based on real complex terrain & forest wind farm in Heilongjiang Province. Comparing different methods and defined the combined CFD technology and ANN statistical correction method which can provide a greater accuracy in forecast.

Key words: wind power forecast  CFD  linear statistical method  ANN method
34-CFD Modeling of Forest Canopy Flows: Input Parameters, Calibration and Validation

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Abstract: Develop improved and validated CFD models in forest zone, and gain an enhanced understanding of the interaction influence of forestry and topography, wind flow simulations on forested zone have been performed with computational Fluid Dynamics (CFD) software Meteodyn WT, which allows introducing custom forest canopy model. The influence of parameter changes on results is investigated. The calibration of model parameters is done by minimizing the error between the CFD results and the vertical wind profiles given by the European Standard Euro code 1 (EC1), applied to standard terrains for high roughness cases. The calibrated model shows good coherence with EC 1. To check the validity of the forest modeling in the real case, CFD simulation has been performed on a site with heterogeneous forest covering. The computed wind characteristics are then compared to met mast measurement. The comparison shows good agreement on wind shear and turbulence intensity between the simulation results and the measured data. Through the research, we confirmed that CFD offers significant benefits in complex forestry and it provides accuracy assessment results in real projects.

Key words: wind flow simulation; forest canopy model; CFD; wind engineering

35-Results of a concept study for a 12MW offshore wind turbine

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Abstract: This paper shows the intermediate results of a concept study for a 12 MW offshore wind turbine. Baseline of the concept study is a 6 MW offshore turbine out of the product portfolio of MECAL Wind Turbine Design (MECAL WTD). At the beginning of the investigations it is checked if and in how far the common scaling rules are valid, as scaling from 6 MW to 12 MW means doubling the rated power.

Design driving loads are scaled from 6 MW to 12 MW.

Further, the main cost drivers for offshore wind power projects and the applicable criteria for concept selection are defined. Based on defined criteria, the most appropriate drive train concept is selected and a reduced load set is simulated.

A conceptual CAD design of the 12 MW offshore wind turbine is created based on initial analytical calculations. Finally the bottlenecks for the realization of at 12 MW offshore wind turbine are identified and possible solutions are defined.
Abstract: Shifting to a low-carbon economy will require current emitting countries and projected future emitters to rapidly scale up their investments in renewable energy. In recent years, major emerging economies like China, India, and Brazil have been catching up with leading developed country investors in Europe and the United States. By some estimates, China is already the leading global investor in renewable energy infrastructure, and is increasing its overseas investments in renewable energy, particularly solar and wind. If China achieves its goal of sourcing 15 percent of its energy mix from renewables by 2020 and 30–45 percent by 2050, renewable energy will become closer to a mainstream energy resource within the country. Cost reduction incurred in this process would benefit not only China, but also the rest of the world.

This working paper aims to help policymakers, investors, and researchers better understand the trends in China’s overseas investments in the wind and solar industries, and the factors behind those trends. It examines the scale, nature, and types of China’s overseas investments in the wind and solar industries, and identifies the policy and market factors that drive these investments.

China has made at least 124 investments in solar and wind industries in 33 countries over the past decade. Of the investments for which data were available, the cumulative value amounted to nearly US$40 billion in 54 investments, and the cumulative installed capacity added was nearly 6,000 MW in 53 investments. Of the 124 investments, 41 were in the wind industry, 81 in the solar industry, and 2 in both the wind and solar industries.
37- Variable Speed Wind Turbines based on Electro-Mechanical Differential Systems

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Abstract—This paper introduces a new electromechanical energy conversion concept for use in wind based power generation systems. Modern wind turbines use frequency converters to meet the speed control requirement. But voltage source based frequency converters typically have limited overload capability. In addition, they fully or partially decouple the rotating masses of wind energy converter (WEC) systems thereby removing altogether or reducing the inertia as a medium of energy storage and modulation from the perspective of the grid during transient conditions. In the proposed concept a drive system based on electromechanical differential gear including a servo motor is used for generator torque control, while using a synchronous machine as the main generator. The system thus provides the speed variability required for optimal utilization of wind energy combined with the advantages of a directly grid connected synchronous generator. It as a result permits the supply of high currents during faults to the grid to provide more effective voltage support as there are no electronic circuits in the main power path, which would limit the overload capability. Furthermore, the inertia of the system comes fully to bear, thus contributing to the overall grid inertia. The performance of the system has been studied experimentally on a prototype system and the results of the conceptual analysis have been verified. Using the mathematical model of the system a grid fault simulation has been performed, and the response during fault and the damping behavior has been studied. The results show the excellent damping behavior due to the active damping control by the differential drive.
38-A Preliminary Study on Design of Reinforced Concrete Tubular Tower For Wind Turbine

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Abstract: China is the leading country with the highest wind power capacity in the world. Along with the unit capacity of wind turbine increasing, more and more researchers pay attention to the structural design of wind turbine towers. At present, although the most popular tower form is steel structure, reinforced concrete tower relative to steel tower is easier to be got in material, easier to be transported, and it has lower cost, higher stiffness, better stability, higher corrosion resistance, less steel consumption and lower maintenance cost, resulting in a certain development prospect. At present, the design research on reinforced concrete tower is scarce, so this article analyzes the reinforced concrete tubular tower subjected by wind load and finds that the variations of reinforcement and concrete quantities with tower thickness at a constant outer diameter, and the variations of reinforcement and concrete quantities with outer diameter at a constant tower thickness, which provides a reference for the application of reinforced concrete tubular tower.

Keywords: wind turbine tower; structural form; reinforced concrete tubular tower
39-Wind Energy: The Solution to Conventional Electricity Production’s Impact on Water Health

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Abstract: Many have detailed wind energy’s environmental benefits; however, one often overlooked is improvement in water body health. Conventional electricity generation’s impacts to water include excessive water consumption for cooling purposes, changes in temperature and dissolved oxygen from discharged water, and impingement and entrainment of fish. In the U.S., thermoelectric plants withdraw 49% of the total water withdrawn, which amounts to 201 billion gallons a day. This exceeds all other uses such as irrigation and industry, and thermoelectric plants use this water for free or little cost. The U.S. Environmental Protection Agency estimates that annual impingement and entrainment in the Mid-Atlantic kills the equivalent of 990 million 1-year-old fish, which is an estimated loss of $3 million to commercial fisheries and $26 million to recreational fisheries.

If a 500 MW wind farm replaced a 500 MW thermoelectric plant, large amounts of water, money, and organisms would be saved. Depending on the type of cooling water intake system that is replaced, between 2 and 130 billion gallons of water would not be withdrawn and discharged, and between 400 and 800 million gallons would not be consumed. Assuming a modest rate of $1,000 per million gallons, this could amount to hundreds of thousands of dollars a year in benefits. This ranges between $0.23 and $0.53 per MWh. Considering benefits to fisheries and ecosystems, the monetary savings could be even higher. Regarding sheer number of organisms, between 10 million and 25 million fish and shellfish could be saved each year.

Thermoelectric plant’s excessive use of water eliminates fish and disrupts habitat, and this impact is rarely accounted for in the market. This water impact externality demonstrates market failure. This is an opportunity for policy-makers to attribute these benefits to the wind industry. If the damages caused by conventional energy were monetized and taxed or mitigated through tradable permits, this could encourage a new wave of wind energy development. We estimate the benefits could be $1 to $2 per MWh. This provides a new perspective for public outreach. Stakeholders like fishermen, agricultural, and residential groups may support wind energy in light of these benefits. In addition, the uncompensated consumption of water and loss of organisms can be seen as a violation of public trust. In conclusion the often ignored impacts of electricity production on water could illuminate wind energy’s benefits.

Keywords: Wind power, water impacts, fish, recreational fishing, commercial fishing, stakeholder engagement
40-Improved wind-turbine technology for the structural loads reduction and protection of damage

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Abstract: The report of Wind Power Incidents in China which was published on April 1, 2013 says, “In some instances, the entire turbine falls down, the main shaft breaks, the motor catches fire, the gearbox becomes damaged, and blades rupture”.

This paper is meant to explain the current technical possibilities to equip wind turbines. It gives information how to increase the safety of wind-turbines, and to improve the economic success of the investment. All the technical details, as described, have been developed by engineers of SETEC-Dresden.

Furthermore important are the costs of the turbine, as well as expected expenses for maintenance and repairs. A modified strategy for control of the rotor-blade allows a general improvement of profitability. A significant reduction of loads in extreme wind conditions has been achieved by the engineers of SETEC. Thus, for example, rotor blades that are designed for wind class IEC-3, can now be used for sites of wind class 2, but this is not only true for the blades, but for the entire system. The crucial factor is the recognition that there are ways to reduce maintenance, and to save material. It is furthermore vital to improve the reliability of the system, which has caused serious damages to the wind-turbines. This deficiency has led to a huge increase of insurance rates.

Characteristics of an improved technology are the use of generators with a higher efficiency and the increase of the rotor diameter.

In order to improve the described criteria, it is necessary to modify the design of existing wind-turbines. To improve safety, the drives for the control of the rotor-blades are equipped with an additional safety feature. Consequently towers don’t fall over, due to poor braking, nor burn down, and no rotor blades are destroyed by over-speed. The common technique of using drive-train gears can be replaced by a direct drive. This is now possible without causing higher costs. Thus the whole system will be drastically simplified, given that oil and hydraulic tanks are completely replaced.

Key Words: Pitch-drive; Control-system: Pitch-master-control; Wind-power engineering
41-Pioneering a revolution in anemometry: achieving acceptance of lidar in the wind industry

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Abstract: Lidar has now achieved a high level of acceptance in several applications throughout the wind industry, including resource assessment (onshore and offshore), power curve evaluation, and turbine-mounted measurements. This was far from the case when the first lidar measurements were made from a turbine nacelle in 2003 [1]. The continuing increase in lidar’s use can be attributed to several factors including improved reliability and cost, and the accumulation of independent evidence of good performance of mature products from established manufacturers. Important considerations for the acceptance of lidar in delivering finance-grade wind data include lidar calibration, verification and traceability. The main sources of uncertainty will be outlined below for wind speed measurement by continuous-wave (CW) coherent laser anemometers; ZephIR is used as an example throughout this paper. The standard ground-based ZephIR emits approximately 1 Watt of eye-safe (laser Class 1) infra red radiation in a conical scan pattern, allowing wind speed, direction and turbulence to be measured at heights ranging from 10m to 200m above the unit. The design exploits advances in optical components developed during the telecommunications boom, the first commercial model being launched in 2004. The results presented here have been obtained with the most recent ZephIR 300 model, introduced in 2011. The application of this type of lidar in various scenarios relevant to the wind industry will then be described.
42-Extending Long-term Wind Data: Engineering vs. Atmospheric Modeling

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Abstract: The amount of wind received at a project location varies rapidly over time and space and is directly correlated to wind energy production. Understanding the risk of variability at a proposed site is crucial in determining its financial viability as a project. For this reason it is critical to have accurate, long-term wind data at a wind site prior to installation. On-site measurement data from an installed met tower is typically the best way to obtain wind data records, but typically offers only very short-term records (6 months-2 years) and there is no way to determine if the measured record is a high, low, or average wind period compared to the long-term. To solve some of these issues, engineering methods have been introduced, which extrapolate wind conditions from short-term, on-site measurements for different heights and for longer periods of time using long-term, off-site measurements. This technique is known as MCP or Measure-Correlate-Predict and is relatively inexpensive because it uses simple, linear mathematics that can be performed on a desktop computer. However, this approach relies heavily on access to accurate, long-term off-site reference data and does not perform well when the proposed site and the off-site reference station are in different locations with different wind regimes.

Numerical Weather Prediction modeling, a technique widely supported, enhanced, and tested by the global atmospheric research community, uses complex, physics-based calculations to simulate the interaction between the entire atmosphere and the ground surface of a wind project. These models help overcome some of the weakness of the MCP approach by providing long-term reference data without relying on long-term, off-site data. However, the industry is generally more comfortable with classical assessment approaches like MCP and modeling is presumed to produce larger errors and uncertainty. In this study we will validate the value of NWP modeling by comparing its results against MCP results at a sampling of geographically diverse projects to see which method performs most accurately. We intend to compare NWP model results with MCP results in the “best possible” scenario (with a long period of high quality data in the same wind regime) and the “typical” scenario (using quality controlled reference data from classical sources such as tall tower data).

Key Words: (long-term, wind reference data, assessment)
43-The economic feasibility analysis of district heat supply using wind power to reducing wind power putout limit in Ertix River Wind Zone

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ABSTRACT: In the wind energy resource-rich Xinjiang Ertix River Wind Zone, the major problem in the future development of wind power projects and affecting the expecting wind farm financial benefit is limited output of wind power. District heat supply using wind power is the most direct and effective means to reduce the wind power putout limit in winter. After analysis and comparison of several form of district heat supply, the methods that investing and constructing the electric boiler heating and storage station by local project company, achieving to increasing electric load and promoting wind power consumptive in local grid, is the best methods, and the financial and economic benefits are feasible.

Key words: Ertix River Wind Zone; wind power putout limit; district heat supply using wind power; economic feasibility analysis

44-The Impact and Countermeasure Suggestions for Wind Farm Project Authority Approval Delegation on Industry Development

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Abstract: This paper reviewed the three stages of examination and authority approval policies on wind farm project, explained the industry background and motivation of wind farm project authority approval delegation, analyzed both positive and negative impact of new policy on industry development, finally put forward to some suggestions for wind enterprises to deal with the new policy environment.

Key Words: Wind industry; delegation of examination and authority approval, impact analysis; suggestions
45-Research on the key Technology in the Distributed Wind Farm SCADA System

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Abstract: Distributed wind farms have important economic and practical value. Although distributed wind farms are small wind fields, they give a big contribution. And to ensure that wind farms be safe, reliable and economical operation and realize centralized monitoring management, it is very important to develop distributed wind farm SCADA system. This paper, to solve the problem of distributed wind farm SCADA system information integration and data transmission, puts forward new overall architecture of the monitoring system in which information integration utilizes OPC XML technology and data transit by means of the ZigBee combined with 3G wireless network.

Key words: SCADA system OPC XML technology ZigBee wireless network 3G wireless network

46-The research and development of the dynamic simulation experimental platform of wind turbine master control system

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Abstract: With the development of wind power industry, the constructing of the wind power experimental platform becoming more important. This paper aims at the cultivation of wind power professionals, The semi physical simulation experimental platform uses software to simulate wind turbine aerodynamic and characteristics of transmission system, and realize the wind turbine pitch and torque closed-loop control. Operating control system which pitch regulated control strategy and yaw actuator are real form, the test of control performance and actuator as well as the load are simulating by real-time interacting information.

Keywords: wind power; main control system; dynamic simulation; experimental platform; Semi-physical simulation
47-Modeling and Simulation Procedure for OC4 Project

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Abstract: IEA TASK 30: Offshore Code Comparison Collaboration Continuation (OC4) focuses on the verification and benchmarking for offshore wind turbine design tool. In OC4 phase II an NREL 5-MW wind turbine with a semi-submersible supporting platform is investigated for its dynamical behavior of different design load cases including free oscillation and forced oscillation by regular or irregular waves. Results of different simulation codes are compared and analyzed. Chinese Wind Energy Association (CWEA), one of the task members in the project, uses GH Bladed as a tool to model the semi-submersible and to give the simulation results. The paper presents the modeling procedure and the simulation results for the semi-submersible.

Keywords: semi-submersible, modeling, simulation

48-Based on the IEC and national standards measurement and assessment of power quality of wind turbine

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Abstract: Wind power is one of the fastest growing in the 21st century renewable energy, as the wind farm capacity is more and more big, the impact on the system of power quality is becoming more and more obvious; and wind power is likely to bring harmonic pollution to distribution network, voltage fluctuation and flicker, etc. The paper expounds the concept of wind power quality based on IEC standard, and introduces the measurement process of the main index of wind turbine power quality, last based on the IEC standard and national standards this paper expounds the assessment of power quality.

Keyword: Wind turbines; Power quality; IEC standards; National standards
49-The research of curve shape similarity used for evaluating the conformity of wind turbine external controllers

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Abstract: This paper present the curve shape similarity for evaluating the conformity of wind turbine external controller and control strategy documentation, and a method for judging the similarity of two curves are given in the paper, in order to compare curves’ similarity simulated by external controller. Based on statistical principles, the definition and the measure method for curve shape similarity are given. This paper presents the reference parameters of curves’ similarity between two external controllers.

Key words: wind turbines, external controller, similarity, simulation curves

50-Certification for high attitude wind turbine

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Abstract: With the development of the domestic wind power industry, development for plateau wind resource into people’s vision, but the impact of plateau specific environmental conditions for wind turbines stable and secure functioning brings new challenges. Based China General Certification Center’s “Technical Specification for high attitude wind turbines”, through the analysis of the special environment of the plateau, and the safe operation of wind turbines, proposed new certification requirements and methods for high attitude wind turbine.

Keywords: plateau; high attitude wind turbines; China General Certification Center
51-The design and evaluation of SRP/CS

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Abstract: This paper expounded the definition of SRP/CS based on the standard GB/T 16855.1:2008 (ISO 13849.1:2006), and mainly introduced the design method of SRP/CS. Giving some examples of functions and performance level which wind turbine SRP/CS need to reach. Finally emphasized the importance and necessity of evaluation of SRP/CS for evaluation of wind turbine control system.

Key words: SRP/CS, performance level, Safety function, wind turbines

52-Estimation of the Available Power Using Autoregressive and Markovian Models for the Wind Power Forecast Error

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Abstract: To counter the risks posed by the variability of wind power production, power system operators turn to forecasting in estimating the available power for any day of operation. We present a simple method to estimate the available power using a numerical weather prediction (NWP) –based day-ahead (DA) forecast and a forecast error (fe) time series modeled either as an autoregressive or a markovian process. The method is computationally efficient and lends itself readily to providing inputs to system tools, like the simulation of balancing (SimBa) program being developed by the Danish transmission system operator (TSO), Energinet, to model the market-based, intraday balancing of the country’s power system. In this work, we present the results of a system-level post-hoc analysis of the day-ahead (DA) fe of the onshore wind power forecasts in Denmark over winter periods from 2009 until 2011. We also include the results for two offshore wind farms, which are the Horns Rev I and the Rødsand I. Based on these results, we model the DA fe time series either as an autoregressive moving average (ARMA) or a markovian process. We show that the normalized mean absolute error (NMAE) performance of the simulations approximates the level of the performance of the real system that is about 5.1/12.8% DA error for the onshore/offshore cases. We note that the markovian model gives a better performance than the ARMA model in terms of showing more closely the diurnal features of the forecast error time series.

Keywords: Day-ahead power forecast error, available power, ARMA, Markovian
53- Research of the Wind Farm Gains According to Different Drive Train Efficiency

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Abstract: WTGs could be divided into the following categories by different types of drive chain: direct drive, double-fed, hybrid drive and asynchronous generator with full power converter, different types of drive chain types have transmission efficiencies. Assuming the rotor absorbed the same wind energy; different types of wind turbines could output different power curves due to different drive chains, thus affecting the gain of wind farms. The efficiencies of different transmission chains were compared and analysis in this article, quantitatively analyzed the impact of the drive chain on the wind farm income, combined with the actual economic assessment of wind farms.

Keywords: Direct drive, Double-fed, Hybrid, Asynchronous generator, with full converter, Transmission efficiency
54-ATS-Tall Hybrid Tower Concept Which Enables Future Growth of The Wind Industry in China

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Abstract: Many of the good wind locations have meanwhile been utilized and future projects will have to be built in areas with lower wind speeds. Fortunately the wind conditions in the higher layer of the atmosphere are better and it makes sense to develop high hub towers. In combination with larger turbine sizes and increased rotor diameters large hub height towers yield more energy than conventional towers. Taller towers are perceived as being more expensive due to their initial investment, however given the improved wind shear factor, the increased energy yield and short payback time the Cost of Energy of the wind turbine shows a significant decrease per KWh.

We will show with a case study from ATS that hybrid wind towers can be constructed easy and in a short time. The ATS tower concept has been designed as such that it is easy deployable on a global basis and is reducing the supply chain costs to a minimum. Easy transportable, quick assembly, consistent product quality, no maintenance and 25% more energy yield compared to 100 mtr. towers are just a few aspects which will appeal to the various customer groups and which will be explained in the presentation.

Additionally the turn key installation of the hybrid towers create local green jobs and allow access to local subsidies and incentives.

In short, taller wind towers will enable the global and Chinese wind industry to reach their ambitious future growth objectives.

Keywords: hybrid towers, precast concrete, Cost of Energy, hub height.
55-Anti-freezing design of wind turbine

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Abstract: Because of low temperature and high humidity in high altitudes wind farms in south of China, the wind turbines were affected by freezing frequently and heavily, which cause the total power generation losing and even cause the safety problem. According to these reasons, the anti-freezing design of wind turbine was proposed. The passive coating technique and the active heating technique were introduced in blade design, the ultrasonic anemometer was chosen in wind turbine, the nacelle and the cover of hub were adopted in streamlined, the anti-freezing control strategy was added in the master control program. These designs applied in a wind farm. The result show that the freezing problem was solved successfully and it provide a method for anti-freezing technique development.

Keyword: blade, anemometer, anti-freezing, control strategy

56-Integrated dynamic performance simulation study based on coupled wind turbine system model

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ABSTRACT: To get nonlinear dynamic property of wind turbine drive train and whole system, variable complex dynamic model was developed coupling with aerodynamic, control, electromagnetic effect. The flexibility & transfer function of sub system have been validated by experiment. Base on simulation results including modal frequency, loads, vibration response, the integrated dynamic performance can be evaluated & improved.

KEY WORDS: multi-disciplinary coupling, variable complex, dynamic property
57-Design Methodology Research of the Floating Foundation for the Offshore MW-Class Wind Turbine

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Abstract: As the huge worldwide energy demand, the wind industry with the highest industrialization level has been growing tremendously. However the development of onshore wind energy is reaching saturation, and whilst the offshore wind developing in which the deep offshore wind energy will dominate in future is becoming more and more favorable. To develop the wind energy in far deep sea, it is too much money-consuming to apply the conventional bottom-fixed foundation because of the deep water, and besides the fixed foundation is not convenient to removal after decommission. Hence the floating foundation without limitation of deep water and with good maneuverability and easy to maintenance is favorable in deep offshore wind farm. In this paper, based on the investigations about the development of floating wind turbine in the world and current available success expertise about floating platform accumulated in offshore O/G industry, the design standard, method and work flow are studied according to the operating characteristic of wind turbine, focusing on the type decision of the floating foundation and mooring system, design conditions, key techniques study and etc. Finally a semi-submersible floating foundation is design for some megawatt wind turbine of Goldwind, and also performance validation and code check are performed to meet the design requirement. It is concluded that the design method of the floating foundation provided in this paper is efficient and can be referenced in practical engineering design.

Key words: Floating foundation, mooring system, design method, code check, integrated system coupling
58-Reactive Power Regulation Performance of Direct-Drive Permanent Magnet Wind Turbine

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ABSTRACT: Direct-Drive Permanent Magnet wind turbines (DDPM) connected to the grid via the fully-fed AC/DC/AC converter. The output reactive power and active power decoupling control is possible for DDPMs because of the implementation of space vector control algorithm inside converter, so the constant voltage/power factor control at PCC of wind farm will be realistic so as wind farm operators would like to give full play to the reactive power adjustment capability of DDPM. This paper focused on the reactive power regulation performance of single DDPMs firstly, and then summarizes the important technical issues related to the reactive power control of wind farms in China, also a conclusion has been taken to the reactive power adjustment capabilities of DDPMs, that related to some real measured data and engineering facts.

KEY WORDS: Direct-Drive Permanent Magnet wind turbines (DDPM), decoupling control, reactive power control, voltage control, grid code for wind power generation

59-The Effect of Extreme Wave Loads on the Offshore Wind Turbine

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Abstract: In this article, different water depth and extreme wave height are selected, and the effect of extreme wave loads on the offshore wind turbine in different operating status are investigated, the calculation results also show that the extreme wave are critical to the foundation design.

Key words: offshore wind turbine, extreme wave, load
Mooring system Analysis of Large Floating Wind Turbine Foundation

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Abstract: Mooring system is the important equipment to guarantee offshore large floating wind turbine working normally under extreme sea condition. Along with our country gradually expand the tidal and inshore to offshore wind power development, we indeed need to research the offshore floating wind turbine foundation, and then the mooring system is one important subsystem of the whole floating offshore wind turbine foundation.

We take extreme load in the tower bottom of large offshore wind turbine under idle condition as wind turbine load and the extreme sea state in a China south sea as environment parameter. Coupling analysis is carried out under the 0 ° typical environment load direction for offshore large floating wind turbine foundation and the mooring system, simulating the 3h storm surge and considering the damaged condition of mooring line.

Calculation results show that the design of mooring system in the intact and damaged condition meet the API specification for the general requirements of permanent mooring floating structure design, but also meet the offshore wind turbine arrangement, component endurance and extreme working condition self-storage requirements.

Key words: Large wind turbine; Floating wind turbine foundation; Mooring system
61-Explanations and analysis of lightning protection system certification points for Goldwind wind turbine

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Abstract: So far, Goldwind wind turbine (hereinafter referred to as units) global sales have exceeded 12,000 units, installed capacity has more than 180 overseas units, sold in the United States, Australia, Romania and other 14 countries, and annual unit orders continuing to rise, the wind has been gradually achieve its globalization strategy. But at the same time a number of overseas users of our crew certification requirements put forward, such as GL, UL, SSDA certification, most of which were certified reference wind turbine certification guidelines (GL certification guidelines). Now Chinese wind energy market, many machine products, blades products, parts of products and raw material products have achieved Germanischer Lloyd certification. Lloyd certification is widely adopted IEC international standards, certification guidelines set forth in the lightning protection requirements of the various components of the system, the paper is easy to overlook one of the more important and where to focus on presentation, including blades, bearings, tower, surge protectors and earthing systems.

Key words: Wind turbine generator  lightning protection system  surge protection device  earthing system
62-Installation Challenges Posed by Extreme Ground and Environmental Conditions

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Abstract: There are a significant number of challenges and risks to be faced throughout the development and operational life cycle of an offshore wind farm; from acquiring financial backing, ensuring you have an experienced team, local opposition, local site conditions, acquiring materials, vessels and ports; the list can appear endless. The challenge to the developer is to assess these risks, to determine if they are “show stoppers” and find workable solutions or to establish whether mitigating the risk to “as low as reasonably practicable” (ALARP) levels is sufficient to allow the project to continue.

In the Asia region local ground and environmental conditions can be the two most challenging risks to assess, with local ground conditions varying between very hard/fractured volcanic rock to 10’s of meters of soft/unconsolidated alluvial sediment. In parallel to this highly sensitive ecosystems exist with rare species that require protection and consideration throughout the project life cycle. These factors must be evaluated in the early stages of development as they are critical to project feasibility.

With a comprehensive understanding of the local ground and environmental conditions, experience of the practical solutions previously employed for similar problems and knowledge of what is possible to achieve with optimisation of local offshore installation vessels; many associated risks can be mitigated giving your project the best possible chance of success.

GL Garrad Hassan and Fugro present common ground and environment related “show stoppers”, and discuss the practical engineering solutions they have developed to tackle them. These include; geotechnical considerations, appropriate foundation selection, installation methodologies, optimisation of existing vessels, environmentally sensitive development strategies and effective ground modelling.

Key Words: Ground Risk, Environmental Risk, Wind Farm Development, Solutions
63-Application of High Resolution SAR wind retrievals to Off-Shore Wind Resources Assessment in China

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Abstract: In view of the high cost and sparse spatial resolution of the offshore meteorological observation, wind maps retrieved from satellite synthetic aperture radar (SAR) data are valuable in offshore wind energy planning as a supplement to on site measurements, which is crucial in offshore wind resource assessment. The advanced SAR maps monitored by Envisat in 2002 have been widely used in off-Shore wind resource assessment in Europe. The technical methods of off-shore wind resources assessment at Hangzhou Bay using ~1km*1km SAR wind retrieval are investigated in this paper. Comparison of the in situ wind speeds at Hangzhou Bay and SAR wind retrieval shows that (1) the relative errors of most off-shore observation stations (23/24) are less than 40%, of which 16 stations less than 20%; (2) high consistency has been found on the wind energy parameters (shape parameter and scale parameter) calculated by the SAR wind retrieval and the in situ wind; (3) compared with the control experiment, when the SAR wind retrieval assimilated into the numerical model (WRF), it shows a significant improvement on the wind speed correlation coefficient at most observation stations and some decrease in standard deviation as well as relative error.

Key words: SAR wind retrieval, high resolution, numerical simulation, data assimilation, off-shore wind resources assessment
64-The waste grease collection system for wind turbine bearing

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Summary: The waste grease in wind turbine main bearing, pitch bearing, yaw bearing, generator bearing are normally be collected by bottle installed in baring periphery, which is of bad effect, and the bearing damaged owing to the waste grease can’t be removed timely. By the centralized waste grease collection system, the above problem will be totally solved, the waste grease in bearing can be removed timely, and the new grease can be injected into bearing with out resistance, the bearing is on good lubrication condition.

Keyword: Bearing, waste grease , automatically remove centralized collection

66-Wind turbine drive system components of super element modeling research

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Abstract: It is very important to model wind turbine drive train dynamics model. Not only the wind turbine drive train dynamics model could help designers to understand the dynamic behaviour of drive train, but also could help them to make sure that the wind turbine won't have resonance which would let structural component premature failure .However, the key point to compete this is to set up finely drive train structural component super-element model. This paper discusses the influence of flexibility within the MBS approach for wind-turbine drive train modeling and validates them, by means of simulation test.

Key words: wind turbine; drive train; super element modeling
67-Dynamic characteristics certification of Wind Turbines drivetrain

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Abstrac: In recent years, the wind power industry suffered lots of units early work, solve the problem of economic losses brought wind farm owners and console manufacturers, and these problems often focused on the transmission system, mainly due to in the design stage of the wind turbine, no accurate dynamic characteristic of the checking work crew, underestimated the design load of the transmission system. So on the development of wind turbine, the dynamic characteristics of the transmission system for the design of accurate assessment certification, is to make sure it doesn't happen in normal work violent vibration, continuous and stable operation.

Key words: wind turbine; drivetrain; design certification

68-The Numerical Simulation and Analysis of Special Low Wind Speed Airfoil for Wind Turbine

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Abstract: The aerodynamic performances of special low wind speed airfoil LCB09150 designed for wind turbine by North China Electric Power University was studied at Reynolds number 300000 and 500000 via the Fluent software with analysis contrasted to the traditional airfoil of NACA4412. Results show that: under the conditions at same Reynolds number, the airfoil LCB09150 has a higher maximum lift-drag ratio and a bigger lift coefficient; and can save the blade materials, reduce weight and lower cost due to the blade chord decreases. This paper provides a reference for the design and study for special low wind speed airfoils.

Keywords: wind turbine; low wind speed airfoil; low Reynolds number; light weight; low cost