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COMPARISON OF THREE AEROELASTIC CODES ON PARKED WIND TURBINE UNDER EXTREME WIND SPEED CONDITION

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Abstract:

Among Renewable energy source, especially offshore wind energy gains prominence because energy potential of offshore wind is abundant in Japan. Toward widespread use of offshore wind energy in Japan, accurate computation of coupled wind turbine structural dynamics, aerodynamics, hydrodynamics, mooring dynamics with control algorithms is highly significant for design optimization and certification process of offshore wind turbine. In design process, all of design load cases (DLCs) which are prescribed in IEC61400 have to be analyzed for load estimation in order to design wind turbine components. In some wind turbine designs, maximum ultimate load is expected for some components to occur under extreme wind speed condition in DLC6.x, even though wind turbine is parked with rotor brake or idling to minimize loads. This research focus on vibration problem under 50-year storm conditions while rotor is parked and blades are feathered. In this parked scenario, effect of a wind direction change of up to ± 180 degrees for both cases of standstill and idling is analyzed by time domain simulations using three different coupled aero-hydro-servo-elastic codes. Trend in modern wind turbines is development of bigger, lighter and more flexible rotors where vibration issues may cause aero-elastic instabilities which have a serious impact on the ultimate loads. The DTU 10MW Reference Wind Turbine (RWT) is chosen as wind turbine model in this research..

DTU 10MW wind turbine model is chosen to analyze by using various aero-hydro elastic-control dynamics computational tools. Ultimate load case for parked wind turbine is analyzed under extreme wind condition that is specified in IEC61400. In specific yaw misalignment case, we observed significant vibrations in time series data of edgewise bending moment at blade root.

Experimental Investigation and Simulation of Effect of Turbulence Intensity on Performance of Horizontal Axis Wind Turbine

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Abstract:

Up to now, wind energy is increasingly large proportion of renewable energy sources in the world and wind turbines are also larger (both hub height and blade length). Many recent papers have been shown reduction of wind turbine structural loads, maximization of wind energy capture and stabilization operation of wind turbine in order to protect the wind turbine components and reduce the cost of wind energy. The aerodynamic behavior of a horizontal axis wind turbine in a uniform inflow, i.e. same wind speed and direction at all the points, is today well understood and can be modeled quite accurately. In fact, however, the inflow is usually unsteady and continuously change because of the difference terrain, wind shear etc., which make fluctuations of the wind speed and directions around the mean profiles. The purpose of the paper is to assess the impacts of turbulence intensity to performance of a HAWT. A three-bladed wind turbine model is chosen to be researched and analysis effect of turbulence intensity on performance of wind turbine in wind tunnel. An Avistar airfoil is used for blade sectional shape of the three-bladed wind turbine. The rotor diameter is 1.6 m. The impaction is considered as turbulence intensity, power output P, tip speed ratio λ. In order to generate turbulent wind, an active grid system is assembled in a wind tunnel. The active grid system is adjusted to generate turbulent wind condition by 24 servo motors. The approaching flows included low-turbulence smooth flow of 1.6%, grid-generated turbulent flow of 10.5% (in the experiment) and high turbulence intensity of 20% (in the simulation case). Wind velocity is measured by hot wire anemometer. A reference wind velocity of approximately 7.5 m/s were used in all the experiments and simulation case.

To simulate operation of wind turbine in turbulence condition, the QBlade software version 0.91b is used. The QBlade software based on the classical Blade Element Momentum (BEM) theory coupling the momentum theory or disk actuator theory, a mathematical model of an ideal actuator disc, with the blade element theory which describes the local events taking place at the actual blade. The turbulence intensity effect issue on wind turbine performance is also investigated by FAST (Fatigue, Aerodynamics, Structures, and Turbulence) code version0.8. From results of experiment and simulation, there are quite disagreement between them because the input data of QBlade software was not modelled with sufficient fidelity compared with wind turbine model. In addition, the results from the experiment study performance of wind turbine in the turbulence intensity in the incoming wind field will be discuss in the next session. The wind turbine load is considered in the turbulence condition and the some other results will be also shown in final part of this paper.

Severe conditions and complexity of Mongolia's 1st Wind Farm

Ts Sukhbaatar

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Abstract:

Compared with central Asian Countries, Mongolia is effecting from global warming more seriously. Other hand air pollution in Mongolia, especially in settled areas is going a disaster.

The constituent policy in Mongolia is focusing more mitigation actions against global warming and air pollution. One of solution of air pollution crisis in worldwide is to use more renewable energy sources such as wind power to avoid more fossil fuels burning and to mitigate global warming.

Subject of the paper will concern about relevant wind energy resource in Mongolia and about the construction severity of the 1st wind farm in central Mongolia nearby Ulaanbaatar.

Problems on power market liberalization and on the integration, and curtailment issues were described in the presentation.

It will be introduce about first experiences of large scale wind farm in remote areas where turbines have to work under extreme conditions of an onshore sole wind farm which is operating in temperature range -40°C to +30°C in Mongolia.

The cold conditions and temperature changes are big challenge to the Wind Turbines and its maintenance and repair. Services and maintenance have to be postponed because of restricted access caused by weather conditions and it impacts on turbine availability and profitability.

The paper is intended to know that the operation teams are learning how to best process and use the information provided by SCADA systems in their operational strategies. How can be used available data to improve the services and maintenance efficiency, minimize downtime in high wind days, and maximize the power production. Cold weather de-rating and icing of the wind turbines during the cold winter operation makes various difficulties. Application of the wind forecast analysis and condition monitoring opportunities in the wind farm. The operation and service team must work out in the field, sometimes in difficult weather conditions. This can present both challenges and opportunities.

This paper is not intended to be an in-depth study of all the opportunities but to give knowledge on conditions and problems in Mongolia’s emerging wind resources application and its future.

Wind Power Project in Bhutan

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Abstract:

As a renewable energy project for the first project in Bhutan, Himalayan small country, a wind farm by two 300kW wind turbines was completed in Rubessa, Wandi Phodrang District, on January 2016. Komaihaltec Inc. of 300kW wind turbine, named KWT300 has been adopted.

Considering the Bhutan of road conditions based on the information of “Resarch and data collection of basic information of renewable energy in Bhutan” wind turbine size capable of being introduced into Bhutan is found to be 300kW scale as a maximum. Elevation of the site is 1300m, relatively low altitude in Bhutan, and climate is also warm area. According to a survey by the US National Renewable Energy Laboratory (NREL), The areas along to several rivers which run from north to south are strong wind area.

The wind conditions survey at 20m height was carried out, annual average wind speed is 5.7m/s, it can be not so much higher wind speed. However, it can be found from the graph indicated below, there is a feature that very high probability of wind speed over 9m/s is occured .We have to pay attention to this featune that the characteristics of the wind varies with wind speed.

Implementation location of this project is also located along the Puna Tsang chu River, is known as a strong area of wind from a long time ago.

In the paper, the project overview and the examine contents are introductioned. These are the influence on the wind turbine at high altitude and the implementation contents of the transport and construction in the field that was extremely severe condition.