

PAPER-1

Wind Energy: Soft Pathway to Energy and Environment Conservation

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Abstract: Energy conservation decreases energy requirements, promotes energy efficiency and facilitates development of renewable. Wind turbines do not need any type of fuel, so there are no environmental risks or degradation from the exploration, extraction, transport, shipment, processing or disposal of fuel. of all the renewables, wind energy dominates as an immediate viable, cost effective option which promotes energy conservation and avoids equivalent utilization of fossil fuels and avoid million ton of Green house gas emission causing ozone depletion and other environmental impacts like Global Warming. Technology upgradation, fuel substitution by superior alternative and clean energy, process improvement of present production activities, efficiency improvement in consequence to R & D efforts are few pathways to energy and environment conservation.

Keywords: Energy Conservation, Externalities, Green House Gas.

PAPER-2

Pawan Shakthi 1800 kW Wind Electric Generator

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Abstract: The main objective of this project was to design and manufacture a 1.8 MW variable speed full fed Wind Electric Generator (WEG). Selling involves proper erection and commissioning of the above said WEG. The technology behind this WEG is an advanced one and highly suitable for medium and low wind sites of India. To achieve smooth integration of the turbine with the grid, grid fault ride through, good power regulation and to minimize reactive power consumption, power electronic converters are used between the wind turbine and grid. In general, the power electronic converters used in wind turbines are soft starters, DC choppers, partial converters and full converters. Generators used in wind turbines are Synchronous, Asynchronous (Induction) and Permanent Magnet Synchronous Generators. Normally, wind turbine manufacturers prefer induction generators for their simplicity and ruggedness. Moreover, induction generators are very easy to control and maintain. In our new product, we have introduced full converter technology with asynchronous generator to achieve the above said benefits.

Keywords: Rotor Blade, Critical Components Pitch system..

PAPER-3

Wind Power Training Initiatives and Models in Sweden – A Case Study

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Abstract: LIFE Academy has successfully developed a model of training based on Result Based Management (RBM), aiming at reaching long term effects (impact) of the training with a strong coupling between Output and Outcome. The key factors are “de-individualization” of the training and focus on organizational changes in countries with ongoing reforms and change processes. Participants are trained to take on the role as Change Agents in their countries. The training includes a program on Wind Power Development and Use.

Keywords: Reforms and change processes, impact change.

PAPER-4

Grid Connection of Renewable Energy Projects in South Africa

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Abstract— This paper gives the background to the Renewable Energy Programme in South Africa. It discusses the immediate implementation challenges, and focuses mainly on the technical aspects considered for wind energy projects to be integrated into the national electrical grid.

Keywords— Wind energy, electrical grid connections, Network Planning Eskom South Africa.

PAPER-5

The Economically Feasible Potential of Wind Power Development in The Republic of Moldova

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Abstract — The article attempts to identify the economically feasible potential of installed capacities (MW_{inst}) of wind turbines in the Republic of Moldova. Main results to highlight from the analysis include (a) Renewable targets are achievable at modest costs, and can be delivered at even lower cost if energy efficiency measures are implemented in parallel. (b) The most cost-effective path for achieving a high renewable energy system is wind generation and increase of biomass use in the electricity and heat sector. These outputs provide some guidance as to where to focus policies and incentives to promote renewable technologies. Incentives must be in place to ensure the required investment levels in these technologies. In addition, further analysis beyond the technical costs and performance needs to be considered, to assess all aspects of feasibility. (c) A higher renewable generation target results in higher costs. However, it can also achieve important co-benefits of enhancing energy security and lowering carbon emissions, and perhaps creating opportunities to see both renewable energy and CO_2 permits to the market.

Keywords — wind turbines, renewable energy sources, energy economics.

PAPER-6

GEORGIAN WIND ENERGY ATLAS

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Abstract: *After disintegration of the Soviet Union, Georgia, whose power supply system was a part of the USSR power supply system, underwent an energy crisis. That caused recession of national economy and standard of living. Import of energy and organic fuel negatively affected on the countries energy safety. Taking into account events of recent years, use of renewable energy sources became important in the country's power policy. In order to promote wind power development and use in Georgia, the whole territory of Georgia has been investigated and the materials, given in the Atlas, include all the necessary data for the selection of the grounds, available for wind farms (WF) building as well as for the estimation of technical/economical indices.*

Keywords: *renewable energy, wind power, wind energy.*

PAPER-7

Identifying System Solution Requirements for Indian Wind Energy Sector

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Abstract: *This paper highlights the various system solution requirements that are getting identified in the wind energy sector of India and their technology enabled solutions. Electrical pitch control for normal duty as well as emergency duty using batteries suffers from low battery life and difficult repair and replacements. Ultracapacitor based electrical pitch controls can provide long life and reliable pitch control more effectively. Meeting existing and emerging grid code requirements using conventional reactive power compensation mechanisms are proving challenging. Dynamic reactive power compensation using distributed static compensation techniques are capable of low voltage / fault ride through and fine reactive power control under a wide range of operating conditions. Traditional switchgear configurations have been generically extended for use in the electrical infrastructure for wind*

sector. Unitized Substations, with adaptations such as load break switches instead of conventional breakers can provide a cost-effective and project-facilitating approach for meeting the electrical infrastructure requirements.

Keywords: Ultracapacitors, Pitch Control, DSTATCOM, Reactive Power Compensation, Low Voltage Ride through, Unitized Substations.

PAPER-8

Electronics & VLSI – A Major Driver of Wind Power Plants

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Abstract: The advancements on VLSI and power electronics has been a major factor to make grid connected wind power a reality. With regard to the price of unit power produced, this renewable energy is almost come of age to compete with other forms of fossil fuels. The complexity of the electronics will vary from manufacturer to manufacturer and depending upon the cost and reliability. The electronic controller which consists of the microelectronics and VLSI circuits is the heart of the wind turbine. Programmable Logic Controller (PLC) which is a microelectronic device is used in the pitch drive system, yaw system and other places in the wind turbine. Supervisory control and data acquisition (SCADA) systems play a key role in the distributed control system used to operate and maintain wind farms. This paper discusses about the different types of electronics employed by the various wind turbine manufacturers used in the past, that is being employed presently and that will be the future state-of-the-art electronics in the constant speed and variable speed wind power plants with typical examples of electronic circuits used in the industry.

Keywords: Squirrel cage induction generator, KW.

PAPER-9

Issues relating to Design of Large Wind Turbine Blades

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Abstract: The blades of wind turbine catch the wind and use it to rotate the shaft of a generator. The procedure of design of the blade decides how much power the wind turbine can produce. The size of turbines has grown over the past decade from a few metres to more than 60 metres. So, it is evident that blades should be designed, which extract maximum energy from wind as possible throughout a range of wind speeds, the blades should be durable, quiet and affordable. The largest capacity wind turbine available today are “the Enercon E-126 has a rated capacity of 7.58 MW built in 2007 having overall weight of 198 m (650ft.) with a diameter of 126m (413ft.). The present work analyzes the reasons for the failure of large wind turbine blades. It also investigates the behavior of the blades due to the aerofoil design and due to the material used in the blade design.

Key words: Blade failure, aerofoil design, carbon fiber, fiber glass.

PAPER-10

Maintenance Issues of Geared Wind Turbines with DFIG

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Abstract: India is now becoming a power to be reckoned with in the Global Wind Power Industry and the major players in the business are shifting their operations to Asia. In the early years constant or fixed speed wind turbines fitted with induction generators were quite popular. But these were not very grid friendly. With greater penetration of wind turbines into the grid, transmission system operators brought in stricter guidelines for wind turbines to maintain the stability of the power system. This called for variable speed wind turbines which come fitted with doubly fed induction generators (DFIG), wound rotor synchronous generators and permanent magnet synchronous generators. Maintenance issues are broadly mechanical, electrical, hydraulics and electronics related. They can be both preventive (and routine) and/or breakdown maintenance. As with any machinery, maintenance

issues come along. With the authors practical experience in the field and also with the theoretical knowledge, some of the maintenance issues related to geared wind turbines fitted with DFIGs is discussed in this paper.

Keywords: DFIG, geared wind turbine, routine maintenance, breakdown maintenance

PAPER-11

Study of Voltage Control and Reactive Power Control in Different Types of Wind Power Plants

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Abstract: This paper represents how voltage control and reactive power control can be achieved in different types of Wind Power Plants. At the end, a comparison is made for different types of Wind Power Plants on basis of voltage control and reactive power control.

Keyword: Voltage Control, Reactive Power Control, Induction Generator, Synchronous Generator.

PAPER-12

Pitch Control of Variable-Speed Wind Turbine Using Proportional Derivative and Neuro-Fuzzy Controller

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Abstract: According to control theory of variable-speed and constant-frequency (VSCF) pitch-controlled wind turbine, using proportional derivative (PD), and Neuro-fuzzy (NF) is adopted to predict pitch angle at real-time working condition, and to obtain more accurate pitch angle reference value. Pitch angle control of wind turbine has been used widely to reduce torque and output power variation in high rated wind speed areas. It is a challenge to maximize available energy in the low rated wind speed areas. In this paper, a wind turbine prototype with a pitch angle control based on fuzzy logic and PD to maximize the output power. In the varying high rated wind speed of 6-14 m/s, the use of fuzzy logic controller can maximize the average output power of 180 KW compared at a fixed pitch angle of the blade. Implementation of pitch angle fuzzy logic-based and PD control to the wind turbine is suitable for the high rated wind speed areas. The Simulation by MATLAB and SIMULINK verify the theoretical analysis. It enhances control precision of the entire pitch-controlled system. The aim of this study is to design a simple controller to maximize the extracted energy of wind turbines. In this study the pitch angle control of variable speed wind turbine is best performance of neuro-fuzzy controller.

Keywords: Proportional Derivative, Neuro-fuzzy controller, pitch angle,

PAPER-13

Small Wind Turbines and Small Wind –PV Hybrid Systems for Off-Grid Applications in India

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Abstract: A Small Wind – Solar Photovoltaic Hybrid System is an integration of small wind and photovoltaic technologies, which offer solutions to meet local energy requirements of a specific location. In addition planners often face the challenges to design such hybrid renewable energy systems which are able to harness primarily wind and solar energy in a balanced manner. This paper gives an overview about the current status and a possible development for Small Wind – Solar Photovoltaic Hybrid Systems for off-grid applications in India.

Keywords: Off-grid, Mini Grid, Hybrid system, Small Wind Turbine, Photovoltaics, Bio-energy, Inverter

PAPER-14

Comparative Analysis of Unit Cost of Energy of Three Systems - Grid Tied PV System, Wind System and Wind-PV Hybrid System

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Abstract: Several cities and towns in the country are experiencing a substantial growth in their peak electricity demand. Various industries and commercial establishments e.g. Malls, Hotels Hospitals, Nursing homes etc., housing complexes developed by the builders and developers in cities and towns use diesel generator for backup power even during the day time. These generators capacities vary from a few kilowatts to a couple of MWs. Under such conditions use of grid interactive Wind system, Photovoltaic systems and Wind-PV Hybrid systems seem to be feasible solutions. With the help of life cycle Cost-benefit analysis, unit cost of energy can be calculated. Comparative analysis of each energy system can be done by evaluating the unit cost of energy of each system. This type of economic analysis will be very crucial element for the selection of any renewable energy system (discussed above) This paper presents the comparison of unit cost of energy generation or levelized cost of electricity (LCOE) among three renewable energy systems.

Key Words: Grid, Photo voltaic, Hybrid wind system.

PAPER-15

Testing of Small Wind Turbines -The Need and Knowhow

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Abstract: Small wind turbines (SWT) find application in isolated or stand alone systems, mainly rural electrification, commercial applications (telecommunication towers) etc. They can be standalone or grid-tied. They can be of different types small wind turbines -upwind, downwind, horizontal axis (HAWTs), vertical axis (VAWTs) and different variations of HAWTs and VAWTs. The global SWT market has been on the upswing in recent years. The market for SWT technology is encouraging in India also. Policy interventions by the government and testing of small wind turbines (as in large wind turbines) goes long way in building up public confidence and even for small time investors and households in investing in SWTs. Empanelment calls for routine and type testing of wind turbines. This paper will focus of the issues, methods, problems and related to testing of SWTs and strategies to accelerate the growth of the small wind turbine sector.

Keywords: Small wind turbines, stand-alone, grid tied, HAWTs, VAWTs, type tests, certification.

PAPER-16

Need for Reassessment of Indian Wind Power Potential

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Abstract: Different wind power potential indicated by various well known institutes in India and abroad is mainly based on different assumption of their study. Also due to technological advancement and better modern techniques are now available in India for calculating wind potential, it is need to focus on reassessments. This paper makes an attempt to analyse the reasons for reassessment of Indian wind power potential.

Keywords: Wind Potential India, Reassessment, Revalidation.

PAPER-17

Modeling of Wind-Solar with Diesel/Grid Hybrid System

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Abstract: The wind and solar energy being intermittent, for a reliable source of electric power, a combination of small wind turbine, solar photovoltaic and diesel generator set especially, in remote villages and island is always a good alternative. Despite the continuous availability of sunlight for most of the year in India and good average wind speeds during monsoon season, there are periods when both wind and solar power is not available or not adequate enough. The development of electronics and power electronics, this strategy is also possible as an unmanned automatic system. The objective of this paper is to review the current state-of-art, operation and control requirements of a typical 5kW Wind-Solar hybrid system with continuous power backup either with grid or diesel particularly suitable for commercial applications (telecommunication towers and others). To better understand the operation and control requirements of the present system under study, the same was modeled using MATLAB SIMULINK tool. The associated drawbacks were identified and the strategies for efficient utilization by connecting simultaneously the tri-system to feed the battery and load for economic requirement and availability are suggested.

Keywords: SWT, SPV, DG, Grid, Stand alone, Battery, Efficient utilization.

PAPER-18

World Wind Energy Research Growth Analysis: A Scientometric study

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Abstract: Wind power is being adopted the world over as the most efficient power generation source that does not cause greenhouse emissions. With the raising concerns on climate change, countries are under pressure to turn renewable energy sources and reduce CO₂ emissions. Amongst RE sources, Wind energy proved more successful energy option next to hydro and about 215 GW has been installed worldwide. Earth's commercially viable wind power potential is estimated 72 TW which is five times more than world's total energy demand. With such a huge potential, only very few countries are really using wind power. USA, some of the European countries and Asian countries China and India are using wind energy at a large scale. Wind energy has been least used in African continent, where only very few countries like Egypt, Morocco, Tunisia, South Africa etc. uses Wind energy for power generation. This paper attempts to highlight quantitatively the growth and development of research on wind energy across the globe in terms of research publication output as per Science Citation Index (1970–2011). The corresponding literatures were analysed by Scientometric methods and research landscape was established. The study also discusses detailed quantitative analysis of Indian contributions on wind energy research. About 16, 407 research articles published by the scientists in the field of wind energy was analysed and have identified top countries, scientists and institutions involved in wind energy research. This paper will be of useful for laying strategic plan to improve wind energy research across the globe and also will be of useful for the countries to identify and collaborate with top organizations and resourced persons involved in wind energy research.

Keywords: Wind Energy Research, Scientometric.

PAPER-19

Study of Seismic Risk to the stability of a Wind Turbine Tower

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Abstract: The success of the wind power plant can be directly correlated to the stability of its supporting structures. As such, the tower is the key component of a wind turbine for stable support to the nacelle and the rotor. With this in view, the stability of the tower is the challenging task for the designers and the manufacturers of the wind turbine. As such, based on the type of tower, the major parameters which can influence the stability of the tower have been identified as the wind speed. In addition, the combined effect of the wind speed and the ground shaking during earthquake cannot be ignored. It is the acceleration of the nacelle, which can cause undesirable deflection at the tower top which can lead to tower failure (viz., overturning, breaking and twisting). With an intention to understand the criticality of seismic activities in the site comprising wind turbines, this manuscript intends to highlight various issues such as: incorporation of the suitable design criteria for seismic resistant towers, the technical guidelines of the standard of the country, the local rules and regulation as well as the techno-economic factors.

Keywords: Wind turbine towers, Stability, seismic loads.

PAPER-20

Techno-Economic Analysis of Distributed Generation (DG) Using HOMER Software

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Abstract: Depleting oil and gas reserves, combined with the growing concerns of global warming, have made it inevitable to seek alternative in form of renewable energy sources. In some remote locations, high reliability is offered by providing on-site generation from many small distributed generators. As a result of this, many hybrid systems came in existence like PV cells, wind, fuel cells, micro turbines, diesel and small hydro systems. The system having two diesel generators and a system with wind turbine added to two diesel generators are simulated and compared. The performance of hybrid systems consisting of two diesel generators and wind-diesel system are analyzed. This paper gives simulation results of a system with two diesel generators and a hybrid system with Wind-Diesel hybrid system. HOMER (Hybrid Optimization Models for Energy Resources) power optimization software by NREL is used to simulate and analyze the hybrid systems. The model analyzes the conditions under which a wind turbine is feasible with diesel generators. The system comprises of two diesel generators, a 75kW and a 150 kW. The wind turbine rating under consideration is 65 kW. For a range of diesel fuel prices and wind speeds, the hybrid system is simulated and wind power is feasible for high fuel prices and high wind speeds.

Keywords: Wind Turbine, Diesel Generator, Distributed Generation, HOMER.

PAPER-21

Economics of Wind Power: A Case Study of a Wind Farm in Karnataka

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Abstract: Sustainable development needs judicious utilization of energy sources, which are integral inputs to modern society. In this context, Renewable Energy (RE) sources such as wind, biomass, solar, etc., are of paramount importance in any economy. Currently wind energy is one of the fastest developing RE technology around the world including India. The increasing investment in wind energy is not only significant from the point of view of bridging the demand-supply gap but also from protecting the environmental consideration. Before investing on wind energy a detailed economic analysis is essential to ensure a decent profit for the investor. The economic return from wind mill is a site specific phenomena owing to changes in wind velocity, wind availability, topography etc. In this backdrop, the current paper presents the economic analysis of a wind farm in Karnataka State in Southern India and chooses suitable Wind Turbine Generators (WTGs), rating. Using the empirical data obtained through field study; it estimates values of various economic indices like, NPW, AEW, IRR, PBP, etc., for ascertaining suitability of investment in wind energy. The outcome of the study helps in selection of appropriate WTG ratings in the selected wind farm.

Keywords: Renewables, Wind-farm, Economics, Empirical.

PAPER-22

Strategies to Create Competent Manpower for Wind Energy Industry

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Abstract: The last decade has seen the Indian wind turbine industry growing very rapidly out pacing many other countries, which has resulted in India emerging as one of the leading countries in this sector. However, the irony is that technical education system of the country could not keep pace with these developments, whereby a lack of courses and programmes exclusively devoted to wind energy technology is being felt. And industry is facing an acute shortage of competent wind turbine engineers, technicians and artisans. This is an issue, which requires immediate attention to maintain the productivity of this sector so that sustained growth is ensured. Based on the close interaction with the experts from industry and the academicians working in this field, different strategies are proposed to bridge the gap between supply and demand of competent manpower through long-term education and short-term training interventions. NITTTR Bhopal's pioneering efforts to establish this emerging wind turbine technology in the technical education system is also highlighted here. This paper also suggests how synergic partnerships could be developed between policy makers, industry and technical education institutions for achieving these objectives.

Keywords: Wind energy sector, competency, curriculum, employment potential, wind turbine technology.