Study and Analysis of Power Generation from Wind Turbine using Multi Physics of HOMER

Praful Kumar[1], Raj Bharti[2]
[1]Dept of Health, Safety and Environment Engineering
[2]Assistant Professor, Dept of Mechanical Engineering
[1, 2] Shri Rawatpura Sarkar University, Raipur

Abstract- *The design of hybrid power generation systems have become extremely popular with the increasing need for energy. The proposed work identifies the major risks in wind farm development and to unravel how those risks are controlled. Furthermore, the thesis aimed to investigate how the wind farm industry is working with risk management and to provide suggestions for improvements by researching existing theories on risk management. Lastly, the wind farm development as well as the potential risk reduction of building wind farms. To achieve the purpose, a case study on INOX Wind Limited was conducted where several of the actors involved in the project were interviewed regarding which risks they were exposed to and how those risks were controlled. The risk management plan used by Company for this particular project was analyzed and compared with existing theories on risk management. The results from the study show that the major risks with wind farm development are connected to weather condition. Furthermore, it is concluded that risk management is an area of wind farm development which is taken very seriously and given a good amount of resources. Multiple risk management and hazard conditions are discussed and recommendations are provided.*

Keywords- Risk management, Wind farm, Construction, Safety Measured, JSA, HOMER, Theory, Mathematics, Personal Protective Equipment (PPE) and Test methods

I. INTRODUCTION

Hybrid solar wind energy has become one of the most significant and promising sources of renewable energy, which requires an additional transmission capability and safer means of Maintaining system voltages and reliability. With a large number of distributed generation access, the impact of distributed generations of the grids' security, reliability and stability cannot be ignored. A renewable hybrid energy system consists of two or additional energy sources, an influence learning instrumentality, controller and an elective energy storage system. These hybrid energy systems have become common in remote space power generation applications as a result of advancements in renewable energy technologies and substantial rise in costs of rock oil merchandise. Analysis and development efforts in star, wind, and alternative renewable energy technologies are needed to continue for, up their performance, establishing techniques for accurately predicting their output and faithfully group action them with alternative standard generating sources. The aim of this paper is to review this state of the planning, operation and management demand of the complete PV solar–wind hybrid energy systems with standard backup supply i.e. diesel or grid.

Presented the most important application field of this search are renewable energy resources. Wind and solar energy have being popular ones owing to abundant, ease of availability and convertibility to the electric energy. This work covers realization of a hybrid renewable energy system for a domestic application, which runs under a microcontroller to utilize the solar and wind power. Presented paper proposes a hybrid energy system consisting of wind, photovoltaic and fuel cell. Battery storage is designed to supply continuous power and to provide the deficit power when the combined wind and photovoltaic so presented Solar and wind resources are abundantly available on earth, enabling the usage of photovoltaic (PV) and wind energy technologies on a large plate in most neighbourhoods in the Earth. This paper aims at investigating a global energy supply scenario based of PV and wind power supported by an appropriate energy.

The role of Renewable Energy power sources is the best possible solution today to reduce the increased danger of global warming and the most important type of renewable is Wind and Solar energies which are the most effective. The green power generation resources use power generators in Distributed Generation (DGs) sauces that are in direct relation with the function of micro capacity power generating units of power arrangement that are installed in distribution level of power systems or all segments that loads and energy consumers are place Photovoltaic/Wind turbine/ Diesel generator (GCPWD) Hybrid System with hybrid storage system.

II. HYBRID WIND-SOLAR PV SYSTEMS

This section presents important contribution in the domain of research.

The Intermittent natural energy resources and energy resources seasonal unbalance are the most important reason to install a hybrid energy supply system. The PV-wind hybrid system suits toconditions where sun light and wind has seasonal shifts i.e., in summer the daytime is long and sun light is strong enough, while in winter the days are shorter and there are more clouds, but there is usually an increased wind resource that can complement the solar resource.

The PV-wind hybrid systems especially suit the remote location, which is inconvenient or expensive to use conventional grid supplies. The common type is connecting with battery storage. For PV array, a true south direction without any obstacles facing the sun is needed. For the wind turbine, appropriate wind speed and wind direction are key element to whole system. The turbine should be mounded into non-turbulent wind higher than trees and without other obstacles. Enough space is needed to site the PV modules, wind turbine tower, and also to properly anchor the guy wires. In general, a local cost-efficient, safe, and durable PV-wind hybrid system is composed of the core part (PV modules and wind turbine); PV modules mounting and wind turbine tower; DC- AC inverter; safe equipment such as fuses, disconnects, and lighting arrestor; meters and instrumentation; batteries, charge controller regulator and backup power resource for battery storage systems; and also connection wires, switching, and wall socket.

Photovoltaic (PV) modules convert sunlight into direct current (DC) electricity. Modules can be wired together to form a PV array that is wiring modules in series the available voltage is increased and by wiring in parallel, the available current is increased. However either way, the power produced is the same since watts (power) equals voltage time amperes. A typical PV module measures about 0.5 square meters (about 1.5 by 3.5 feet) and produces about 75 watts of DC electricity in full sun.

III. SYSTEM DESIGN

Most modern controllers maintain system voltage regulation electronically by varying the width of DC pulses they send to the batteries (this is called pulse width modulation or PWM). This means the wider the pulse; the more power goes to the batteries. Another category called "shunt type" controllers diverts excess energy into a "shunt load." This type of controller is more commonly used in wind or hydro systems, since these systems generally should not be run open circuit. Unlike a PV module, most wind and hydro turbines cannot be switched on and off by the controller. A new generation of PV controllers has "maximum power point tracking." They take advantage of the maximum power available in the module by adjusting current and voltage.

Backup power resource can come either from a generator or from the utility grid when too much energy is consumed or when there has not been enough renewable energy coming into the system. However, for the hybrid system, the latter situation seems could be avoid, and a considerable energy consuming style might assist to solve the former problem.

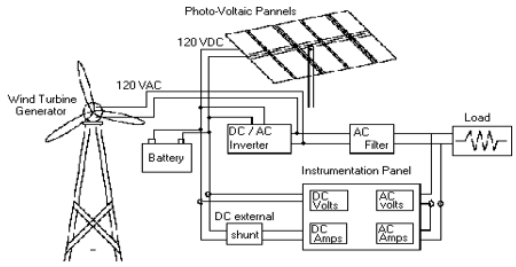

Fig.1 A simple Hybrid Solar & Wind System Methodology

Salient points:

The hybrid unit contains two complete generating plants, a PV solar cell plant and a wind- turbine system. These sources are connected in parallel to a 120V AC line.

1. The PV panel output is connected to a DC to AC inverter and is then supplied fromthe inverters output to a single-phase, 120 VAC load.
2. The wind turbine is installed at the top of a steel tower that has a height of 18.3 meters and a diameter of 8.9 cm.
3. The instrumentation panel depicted monitors the outputs of the generator using digital panel meters. One of the low maintenance features is the turbine's brush-less alternator and an internal governor.
4. The turbine's blades are made of a carbon fiber reinforced composite that will intentionally deform as the turbine reaches its rated output. This deformation effect changes the shape of the blade, causing it to go into a stall mode, thus limiting the rotation speed of the alternator and preventing damage in high kinds.
5. Another feature of the wind turbine is a sophisticated internal regulator that periodically checks the line voltage and corrects for low voltage conditions.

6. The solar panels are 12 VDC/unit were chosen for their ultra-clear tempered glass that is manufactured for long-term durability.
7. The DC voltage measured across the 12 volt DC bus where the wind turbine and PV arrays outputs are connected. A slight ripple in power regulation can clearly be seen. This ripple is a function of the unpredictable nature of sunshine along with the dynamic effects of the electrical load.

Periodic audit

All Sites shall undertake HSE Audit at periodic intervals. Such audit shall be as per the below schedule

1.Annual Site HSE audit – Such audit shall be organized by the Corporate HR function to reviews all the aspect of HSE Management and compliance to all HSE Guideline.
2. Quarterly safety audit will be done by external agency.
3. Half yearly cross audit –interstate internal safety audit by site safetypersonals.
4. Periodic Specific Audit – Such audit shall include the following and shall be conducted by external agencies
5. Ambient air testing once in 6 months
6. Noise Test once in 6 months
7. Fauna audit once in 6 months

IV. RESULTS

The results have been summarized in this section,

The total number of accidents in the wind power industry in terms of deaths and serious injuries is remarkably small, but the percentage is high relative to other industries, due to its being a labor intensive option of energy production. The risks of disease from exposure to hazardous substances are minimal but wind power is characterized by unique industrial risks related to its workers operating under hazardous conditions involving

1. Blade ejection,
2. Runaway turbine disintegration,
3. Tower Collapse,
4. Overheating of generators and transmission lubrication and cooling fluids and component fires.
5. Hazardous weather conditions,
6. Working at significant heights (about 100 m),
7. Use of rotating machinery,
8. Handling heavy equipment,
9. Use of high voltage electricity and cabling,
10. Vehicular access,
11. Lightning strikes causing fires,
12. Hazardous solvent chemicals exposure in rotors manufacture,
13. Oil spills,.
14. Ice shedding.

Many of the involved accidents unnecessarily involve the adoption of shortcuts and ignoring the existing standard industrial and electrical practices. Other risks can be caused by other low probability events such as a blade ejection or a runaway turbine. Mundane risks such as tripping also occur.

Table 1. Identification of Hazardous Areas

S.NO	ACTIVITY	POTENTIAL HAZARDS
1	Working at height	Any emergency during height work activity
2	D.G. operation/ Hot work & Power	Electrical shock, Electrocution/Fire
3	tools application	Any major/minor incident / Electrical shock,
4	Crane functions	Electrocution
5	Men/Material transportation	Road incident
6	Electrical Construction &Commissioning work	Any major / minor incident / Electrical shock,
7	WTG-Tower installation / Machine Installation / Electrical &Commissioning work / De-installation work	electrocution
8	Service, Substation, External electrical activities	Major accidents and shocks,
9	Handling & Storage of Diesel, Petrol,kerosene or other lubricants / Chemicals	Any major / minor incident / Electrical shock

Fig,2 Hazardous Layouts

Title of Improvement:	Lahori Wind Farm - 24VDC L.E.D.Type Portable Hand Lamps shall be used while working inside HUB				
Division	Wind Operation		Department	O&M	
Rec No.	DELTA_Lahori Wind O & M - 005				
Team Members	Vishnu tripathi		Sathieshwaran		
Linkage to BSC / SDM			Facilitator	Neeraj Singh	
EPM Process No:		Improvement Category	Safety & Health	Environment & Sustainability	Safety & Health
Base level (with UoM)	While working inside the Hub facing issue of less illumination	Project/Task Start date	06.08.2017		
Target Level (with UoM)		Project/ Task Finish date	06.08.2017		
Trigger for Improvement	Suggestion / Others (plz specify)	Methodology of Improvement	Structured Problem		

Fig.3 Project Layout

V. CONCLUSION

This paper presents a procedure to establish & maintain documented procedure to monitor & measure the key characteristics of the operations & activities that can have a significant impact on the environment. This procedure is applicable to all processes & services performed inside the all IWISL's site, which can have adverse impact on environment & put affect the regulatory compliance.The risk management plan used by Company for this particular project was analyzed and compared with existing theories on risk management. The results from the study show that the major risks with wind farm development are connected to weather condition. Furthermore, it is concluded that risk management is an area of wind farm development which is taken very seriously and given a good amount of resources. The conditions of hazards and the necessary regulations are presented.

REFERENCES

[1] M. Siva Ramkumar, M. Sivaram Krishnan. International Journal of Advance Research in Computer Science and Management Studies, Hybrid Solar-Wind Energy System: 2014, Volume 02, Issue 02.

[2] Kenneth E. Okedu, Roland Uhunmwangho. Optimization of Renewable EnergyEfficiency using HOMER, International journal of renewable energy research: 2014, Volume 04, Issue 02.

[3] Mohd Rizwan Sirajuddin Shaikh, Santosh B. Waghmare, Suvarna Shankar Labade, Pooja Vittal Fuke, Anil Tekale, A Review Paper on Electricity Generation from Solar Energy, International Journal for Research in Applied Science & Engineering Technology: 2017, Volume 05, Issue 09.

[4] R. Thresher, M. Robinson, P. Veers. Wind Energy Technology: Current Status and R&D Future, Conference paper: 2008

[5] Yamini Sarathi, Khemraj Patel, Arti Tirkey, Prakash Kumar Sen and Ritesh Sharma. Study on wind turbine and its Aerodynamic performance, IJMERR: 2015, Volume 04, Issue 01.

[6] Benjamin McLellan, Qi Zhang, Hooman Farzaneh, N. Agya Utama and Keiichi N. Ishihara. Resilience, Sustainability and Risk Management: A Focus on Energy, Challenges: 2012, ISSN 2078-1547

[7] Chunhui Zhou, Xin Liu, Langxiong Gan. Assessment and Countermeasures for Offshore Wind Farm Risks Based on a Dynamic Bayesian Network, Journal of Environmental Protection: 2018, Issue 09

[8] Ian Prowell and Paul Veers. Assessment of Wind Turbine Seismic Risk: Existing Literature and Simple Study of Tower Moment Demand, SAND: 2009-1100

[9] N. Booij, R. C. Ris, and L. H. Holthuijsen. A third-generation wave model for coastal regions, Journal of geophysical research: 1999, Volume 104, Issue C4.

[10] Mahmood Shafiee, and Fateme Dinmohammadi. An FMEA-Based Risk Assessment Approach for Wind Turbine Systems: A Comparative Study of Onshore and Offshore, Energies: 2014, ISSN 1996-1073

[11] Maria A. Kougioumtzoglou, Iraklis Lazakis. Developing a Risk Analysis and Decision Making Strategy for an Offshore Wind Farm, Cyprus Sea Lines Co Ltd., Greece: 2017

[12] J8osua Kirsch. Design of a small wind turbine fo9r electric power generation (1-5kw), Un10iversity of Suthern Queensland: 2009

[13] Cun-Zheng Ning, Semiconductor nano lasers and the size-energy-efficiency challenge: a review, Spie digital library: 2019

[14] The solar cell under illumination, Alternate lectures: The PV Cells Principal. PV Lecture House: 2016

[15] M. Sojoudi and R. Madatov. Simultaneously Improvement of Heterojunction Solar Cells Efficiency by Electron Irradiation and Varying Series and Parallel Resistances. Research Journalof Applied Sciences, Engineering and Technology: 2012, ISSN: 2040-7467