Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 04, April-2016

A Case Study on Cost Analysis and Emission Analysis for Grid Connected Wind Power System using RETScreen 4 Simulation Software

Smruti Ranjan Pradhan
Assistant Professor
Department: Electrical & Electronics Engineering
Gandhi Institute of Engineering and Technology
Gunupur-765022, India

Vivek Kumar
UG - Student, 4th Year
Department: Electrical & Electronics Engineering
Gandhi Institute of Engineering and Technology
Gunupur-765022, India

Himanshu Sourav
UG - Student, 4th Year
Department: Electrical & Electronics Engineering
Gandhi Institute of Engineering and Technology
Gunupur-765022, India

Ravi Kumar Gupta
UG - Student, 4th Year
Department: Electrical & Electronics Engineering
Gandhi Institute of Engineering and Technology
Gunupur-765022, India

Abstract: **In this modern era due to lack of synchronism between the rise in the energy demand and rise in energy production. The monster of darkness and pollution had already started to imprison the whole mankind. Growing dependency on conventional sources for filling intense hunger of electrical energy has raised a question mark over the existence of conventional energy sources after a few decades from now. Looking into this circumstances we are now bound to look for some alternative for slacking our force of using these sources like coal, natural gas etc. Keeping the same objective in our mind here in this paper we are going for wind energy conversion principle of energy generation and incorporate the grid technology with CETS to reduce consumption of fossil fuels.**

Here in this paper feasibility of this scheme on the grounds of technical complexity and economic viability along with its potential to control the emission of unwanted flue gas is analyzed using RETSCREEN simulation software[1]. We believe that this paper will definitely going to show a way to enhance the life of the conventional energy sources and conserve the beauty of our environment for our upcoming generation.

Keywords: Cost analysis, emission analysis, RETSCREEN 4, simulation, weather condition, Wind Turbine.

(I) INTRODUCTION

The energy demand across the globe is terribly rising every now and then due to rapid population and economic growth across the various geographical location. With this our reliance on the fossil fuel as a raw input for energy production is also gearing up with a very faster rate. Use of these fossil fuels viz. coal, natural gas, diesel etc. poses a great threat to the safety and health of our planet along with the whole mankind. So it induces a strong urge to think upon some another alternative to reduce the pollution and exploitation of our surrounding and thus brings in picture of harnessing different energy sources present in the nature to meet our ever awaited energy demand.

The prime sources available for renewable energy are sun, wind, water etc. Depending upon the types of renewable sources used during power generation, the different types of renewable energies available are geothermal energy, wind energy, tidal energy, solar energy, hydro-electric energy and their integrated sources.

The share of different renewable energy sources towards the power generation in India in terms of percentage are Wind 64.673%, Solar 12.237%, Hydro 10.871% Biomass 11.886% and other Renewable Energy 00.333%.

This study analyses the load flow of any building to use the wind energy power for load analysis with simulation approach in more efficient way by using RetScreen software. The study is a grid based one which is directly connected to the Gunupur Grid for Energy efficient, optimized and economically efficient power system.

(II) PROJECT INFORMATION

The all in one tool for analyzing cost effectiveness, emission and risk covered in setting up a renewable energy replacement for a conventional one. The tool's principal work is to deal with the analysis of energy projects and comparison between energy projects working on different sources. For every analysis done on RETScreen Microsoft excel spreadsheet workbook file comprising of different worksheets are created. Apart from all these RETScreen includes a fully updated database of product, weather and cost and even a training course on the subject.

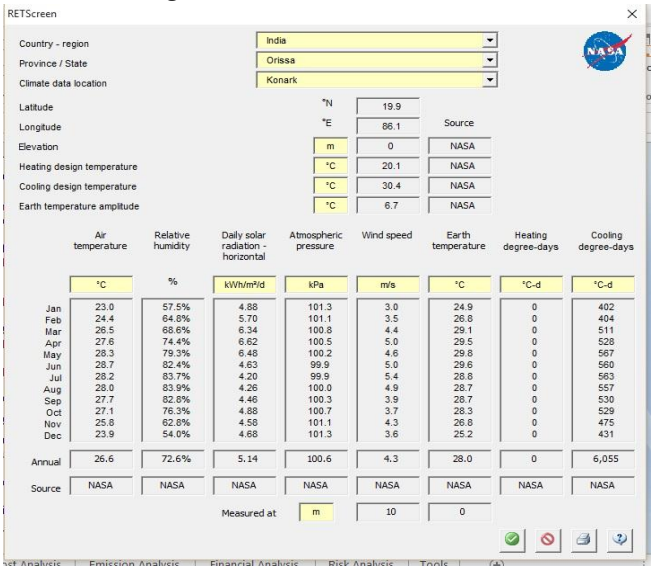
International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 04, April-2016

Project information *See project database*

Project name	Wind Power Plant
Project location	Konark, Odisha
Prepared for	EEE Department, GIET Gunupur
Prepared by	Ravi Kumar Gupta
Project type	Power
Technology	Wind turbine
Grid type	Central-grid
Analysis type	Method 2
Heating value reference	Higher heating value (HHV)
Show settings	☑
Language - Langue	English - Anglais
User manual	English - Anglais
Currency	Rs
Units	Metric units

A. Selection of weather zone.

For project installation a suitable land large enough to accommodate all the equipment need to be marked out. The place in consideration for the project has to be tested upon various parameters such as wind speed, stability, etc. The RETScreen 4 platform then gives all the required data related to the location based upon information from NASA. The required data as displayed by the software is given below.



B. Wind Speed vs Power and Energy Curve Data

The power and energy output for the turbine model named S.66/1250-65 m chosen is depicted by the tabular format shown below here we can observe the minimum wind speed for the power generation(cut-in speed) is 3 m/s. Also the increase in quantity of electrical power produced with speed is also shown over here.

Wind speed m/s	Power curve data kW	Energy curve data MWh
0	0.0	
1	0.0	
2	0.0	
3	17.0	348.7
4	39.6	914.3
5	106.5	1,767.6
6	192.7	2,782.2
7	305.8	3,810.4
8	481.0	4,759.0
9	687.5	5,589.9
10	917.5	6,294.8
11	1,155.9	6,876.1
12	1,250.0	7,338.3
13	1,250.0	7,686.3
14	1,250.0	7,926.5
15	1,250.0	8,068.0
16	1,250.0	
17	1,250.0	
18	1,250.0	
19	1,250.0	
20	1,250.0	
21	1,250.0	
22	1,250.0	
23	1,250.0	
24	1,250.0	
25 - 30	1,250.0	

C. Energy model.

The next and an important part of this analysis is to design the energy model. The software provides a very good method for this purpose. It has a good user interface asking for all the data such as wind speed, temperature, etc.

Commissioning a wind energy conversion system is an important task in the system's design. In the sizing process one has to take into account three basic factors:

a) The average wind speed and minimum cut in speed of the site along with other related temporal data.
b) The daily power consumption and types of the electric loads.
c) The storage system to contribute to the system's energy is independent for a certain period of time.

If wind energy generator is oversized then it would have a huge impact over the final cost of the power produced. while on the other hand, if the
wind energy generator is too compact then problems might occur in meeting the energy demand at any time. The average wind speed at the site of commissioning of wind energy conversion system is expressed in terms of m/s primarily required to provide answer to the amount of power produced by the wind energy generator. The choice of the number of wind turbine depends on user like in fig.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 04, April-2016

Resource assessment			
Resource method		Wind speed	
			Konark
Wind speed - annual	m/s	4.3	4.3
Measured at	m	10.0	10.0
Wind shear exponent		0.4	
Air temperature - annual	°C	26.6	26.6
Atmospheric pressure - annual	kPa	100.6	100.6
Wind turbine			
Power capacity per turbine	kW	1,250.0	
Manufacturer		Suzlon	
Model		S.66/1,250 - 65m	
Number of turbines		16	
Power capacity	kW	20,000.0	
Hub height	m	65.0	9.1 m/s
Rotor diameter per turbine	m	66	
Swept area per turbine	m²	3,421	
Energy curve data		Standard	
Shape factor		2.0	

D. Cost analysis.

This worksheet covers all the financial aspects and comparisons of the project to be undertaken. All costs such as installations, maintenance and periodic needs mentioned for the analysis purpose. Under this section the complete detailed information about the total cost aroused in the establishment of wind energy conversion system. Here the user is considering the total investment in the form of initial cost, running cost as well as the annual maintenance cost with the credit for any base case cost that are avoided in proposed case (alternatively, the user can enter the incremental costs directly). The user has to make choice between performing a pre-feasibility or a feasibility study. For a "Pre-feasibility analysis," less detailed and less accurate information is typically required while for a "Feasibility analysis," more detailed and more accurate information is usually required. Since the calculations performed by the RETSCREEN Software for this step are straight forward and relatively simple (addition and multiplication), the information found in the online manual for each input and output cell should be sufficient for a complete understanding of this worksheet [2]. It provides the details of annual savings and periodic costs. It gives us option of entering all types of costs included in the making of the project. The details of the cost sheet analysis is given as in fig. The complete cost depends on the engineering costs, cost of the inverter and battery systems depending on their ranges and other operation and management costs.

Initial costs (credits)	Unit	Quantity	Unit cost	Amount	Relative costs
Feasibility study					
Feasibility study	cost	1	Rs 2,190,000	Rs 2,190,000	
Subtotal				Rs 2,190,000	0.1%
Development					
Development	cost	1	Rs 6,125,000	Rs 6,125,000	
Subtotal				Rs 6,125,000	0.2%
Engineering					
Engineering	cost	1	Rs 5,200,000	Rs 5,200,000	
Subtotal				Rs 5,200,000	0.2%
Power system					
Wind turbine	kW	20,000.00	Rs 130,000	Rs 2,600,000,000	
Road construction	km			Rs -	
Transmission line	km			Rs -	
Substation	project			Rs -	
Energy efficiency measures	project			Rs -	
User-defined	cost			Rs -	
				Rs -	
Subtotal				Rs 2,600,000,000	86.9%
Balance of system & miscellaneous					
Spare parts	%	2.0%	Rs 616,000,000	Rs 12,320,000	
Transportation	project	1	Rs 200,000	Rs 200,000	
Training & commissioning	p-d			Rs -	
User-defined	cost	1	Rs 95,700,000	Rs 95,700,000	
Contingencies	%	5.0%	Rs 2,721,735,000	Rs 136,086,750	
Interest during construction	9.50%	12 month(s)	Rs 2,857,821,750	Rs 135,746,533	
Subtotal				Rs 380,853,283	12.7%
Total initial costs				Rs 2,993,568,283	100.0%

E. Emission analysis.

Under this section the advantage of using wind energy conversion system as an alternative to the conventional energy sources is explained by observing the amount of reduction of one of the major pollutant carbon dioxide[3]. Here it is shown that by using 20MW wind energy generation station in place of conventional sources based power plant then net annual CO2 emission reduction of 68,118 tones is noticed. In other words which can be stated as by implementing this project we can indirectly say that about 12,476 cars and light trucks contributing to emission of greenhouse gases is not used. And also around 29268409 liters of gasoline is not consumed.

GHG emission reduction summary

	Base case GHG emission tCO2	Proposed case GHG emission tCO2	Gross annual GHG emission reduction tCO2	GHG credits transaction fee %	Net annual GHG emission reduction tCO2
Power project	77,406.9	9,288.8	68,118.1		68,118.1

Net annual GHG emission reduction				
68,118	tCO2	is equivalent to	23,489	Tonnes of waste recycled

GHG emission reduction summary

	Base case GHG emission tCO2	Proposed case GHG emission tCO2	Gross annual GHG emission reduction tCO2	GHG credits transaction fee %	Net annual GHG emission reduction tCO2
Power project	77,406.9	9,288.8	68,118.1		68,118.1

Net annual GHG emission reduction				
68,118	tCO2	is equivalent to	68,118	People reducing energy use by 20%

GHG emission reduction summary

	Base case GHG emission tCO2	Proposed case GHG emission tCO2	Gross annual GHG emission reduction tCO2	GHG credits transaction fee %	Net annual GHG emission reduction tCO2
Power project	77,406.9	9,288.8	68,118.1		68,118.1

Net annual GHG emission reduction				
68,118	tCO2	is equivalent to	12,476	Cars & light trucks not used

GHG emission reduction summary

	Base case GHG emission tCO2	Proposed case GHG emission tCO2	Gross annual GHG emission reduction tCO2	GHG credits transaction fee %	Net annual GHG emission reduction tCO2
Power project	77,406.9	9,288.8	68,118.1		68,118.1

Net annual GHG emission reduction				
68,118	tCO2	is equivalent to	29,268,409	Litres of gasoline not consumed

GHG emission reduction summary

	Base case GHG emission tCO2	Proposed case GHG emission tCO2	Gross annual GHG emission reduction tCO2	GHG credits transaction fee %	Net annual GHG emission reduction tCO2
Power project	77,406.9	9,288.8	68,118.1		68,118.1

Net annual GHG emission reduction				
68,118	tCO2	is equivalent to	68,118	People reducing energy use by 20%

GHG emission reduction summary

	Base case GHG emission tCO2	Proposed case GHG emission tCO2	Gross annual GHG emission reduction tCO2	GHG credits transaction fee %	Net annual GHG emission reduction tCO2
Power project	77,406.9	9,288.8	68,118.1		68,118.1

Net annual GHG emission reduction				
68,118	tCO2	is equivalent to	6,265	Hectares of forest absorbing carbon

GHG emission reduction summary

	Base case GHG emission tCO2	Proposed case GHG emission tCO2	Gross annual GHG emission reduction tCO2	GHG credits transaction fee %	Net annual GHG emission reduction tCO2
Power project	77,406.9	9,288.8	68,118.1		68,118.1

Net annual GHG emission reduction				
68,118	tCO2	is equivalent to	15,481	Acres of forest absorbing carbon

(III) CONCLUSION

RETScreen offers a very reliable and easy to use platform for the effective analysis of all type of energy source replacements.

This software tool keeps into account all the local climatic conditions and metrological data which further enhances the analytical efficiency.

The breakeven point provided by RETScreen based upon the cost analysis calculations gives an insight into the cash inflow and outflow in the project.

The emission analysis gives a realistic advantage of setting up a renewable energy project. This tool is very much helpful for people trying to design hybrid systems for clean energy.

This very project can be taken as the foundation for the grid connected wind energy systems.

ACKNOWLEDGEMENT

We owe a lot to the electrical and electronics energy department for the completion of this project. We are thankful to the department and all its members for successful completion of this project.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 04, April-2016

REFERENCES

[1] www.retscreen.net
[2] Study of Cost Analysis and Emission Analysis for Grid Connected PV Systems using RETSCREEN4 Simulation Software. International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 IJERTV4IS040406 Vol. 4 Issue 04, April-2015
[3] Biogas and biofuel production technologies Balancing Cost and performance in PV/Wind/Battery Hybrid Power System Ahmad Zahedi1, Akhtar Kalam2.
[4] Design of Off-Grid Home with SOLAR-WIND-BIOMASS Energy of Smruti Ranjan Pradhan et al lnt. Journal of Engineering Research and Application, ISSN : 2248-9622, Vol. 4, Issue 1(Version 7), January 2014, pp.22-27.