© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 06 Issue: 05 | October-December 2015

ANALYSING THE EFFECT OF WIND CLASS IN WIND TURBINE ENERGY PRODUCTION

Nipun

Abstract:

This research examines effect of different wind turbine classes in electricity production of wind farms. Wind classes determine which turbine is suitable for normal wind conditions of a particular site. Turbines having higher wind classes have larger blades and produce more energy in low and medium winds, but they are more sensitive in high wind gusts.

Keywords: *Wind Turbine, Electricity, Wind Energy, Wind Turbine Classes*

[I] Introduction

Renewable energy sources are clean, inexhaustible, and environmental-friendly alternative energy sources with negligible fuel cost. Worldwide demand for renewable energy is increasing rapidly because of climate problem, and because oil resources are considered limited. Wind energy supposed as a clean and good solution to cope with a great part of this energy demand.

Wind turbines present several benefits over conventional generation technologies for electricity generation. Reduction of greenhouse gases, contributed to global climate change and to local air quality is one of their major benefits. They reduce risk of fossil-fuel price fluctuations and decrease electricity-sector dependency. Developing a utility-scale wind project is considered complicated and very time-consuming process involving developers, utilities, landowners, public, and various local authorities. Each wind energy project is unique and has different characteristics, basic features and related steps are common. In practice, steps are iterative and overlap with one another depending on specific project circumstances. Key steps of development and planning for a wind farm are site selection, detailed wind assessment, construction, feasibility, and operation.

In order to examine effect of wind turbine class on electricity production, wind turbine data from five different manufacturers have been used. For each manufacturer, two wind turbines with identical rated power and different wind turbine classes [IEC II and IEC III] are compared for both sites. Rated power of chosen wind turbines is between 1.5 MW and 3 MW. Results of present work show that for studied sites, increase in annual energy production of IEC III wind class turbines, compared to IEC II class turbines, is significant in all cases.

[2] Wind Turbine Data

The effect of wind class in wind turbine energy production is examined for five different wind turbine manufacturers. For each manufacturer, two wind turbines with identical rated power and different wind turbine classes [IEC II and IEC III] are compared for both sites. Technical characteristics of ten considered wind turbines are shown in Table 1. Five manufacturers are namely Sinovel, Unison, Vestas, Windey , and WinWind study shows that six wind turbines have rated power of 3 MW, two of them have rated power 2 MW, and remaining two have rated power 1.5 MW. Wind turbines of class III have larger diameters compared to their corresponding wind turbines of class II. Moreover, with exception of Vestas, all wind turbines of same manufacturer have identical hub heights. In each diagram, better performance of class III wind turbines in low and medium wind speeds is obvious, especially in case of Vestas models, which also present greatest difference in rotor diameter [90 m for class II, 112 m for class III].

© INTERNATIONAL JOURNAL FOR RESEARCH PUBLICATION & SEMINAR
ISSN: 2278-6848 | Volume: 06 Issue: 05 | October-December 2015

Paper is available at www.jrps.in | Email : info@jrps.in

Table 1 : Technical characteristics of considered wind turbines-1

Wind turbine model	Wind class [IEC]	Rotor diameter [m]	Hub height [m]	Rated power [kW]
Sinovel SL 3000/105	IIA	105	90	3,000
Sinovel SL 3000/113	IIIA	113	90	3,000
Unison U88-2000	IIA	88	80	2,000
Unison U93-2000	IIIA	93	80	2,000
Vestas V90/3.0 MW	IIA	90	105	3,000
Vestas V112/3.0 MW	IIIA	112	119	3,000
Windey WD77-1500	II	77	80	1,500
Windey WD82-1500	III	82	80	1,500
WinWind 3/109	IIA	109	90	3,000
WinWind 3/120	IIIA	120	90	3,000

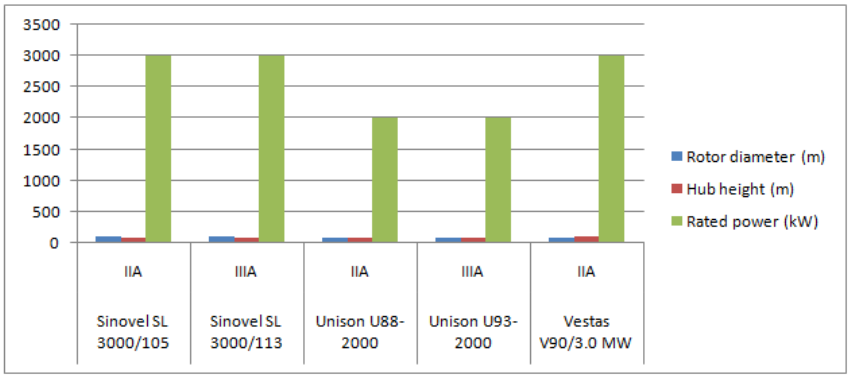

Fig 1 Bar chart of rated power (kw) of Wind turbine model-1

Table 2 Technical characteristics of considered wind turbines-2

Wind turbine model	Wind class [IEC]	Rotor diameter [m]	Hub height [m]	Rated power [kW]
Vestas V112/3.0 MW	IIIA	112	119	3,000
Windey WD77-1500	II	77	80	1,500
Windey WD82-1500	III	82	80	1,500
WinWind 3/109	IIA	109	90	3,000
WinWind 3/120	IIIA	120	90	3,000

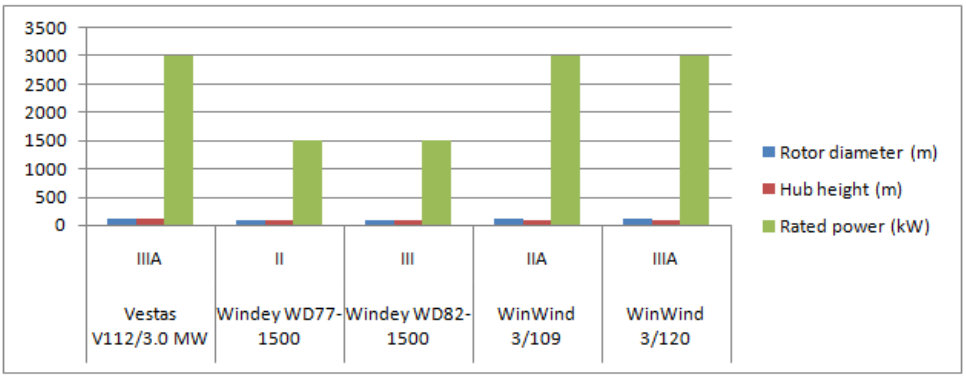

Fig 2 Bar chart of rated power (kw) of Wind turbine model-1

Table 3 Technical characteristics of considered wind turbines-2

Wind turbine model	Wind class [IEC]	Rotor diameter [m]	Hub height [m]	Rated power [kW]
Vestas V112/3.0 MW	IIIA	112	119	3,000
Windey WD77-1500	II	77	80	1,500
Windey WD82-1500	III	82	80	1,500
WinWind 3/109	IIA	109	90	3,000
WinWind 3/120	IIIA	120	90	3,000

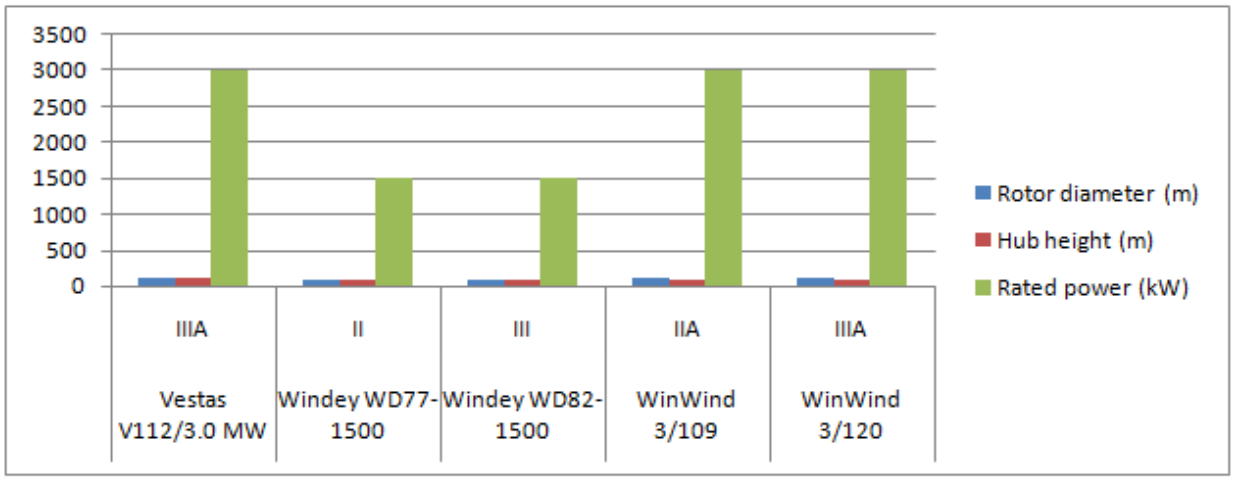

Fig 3 Bar chart of rated power (kw) of Wind turbine model-1

[3] RESULT AND SIMULATION

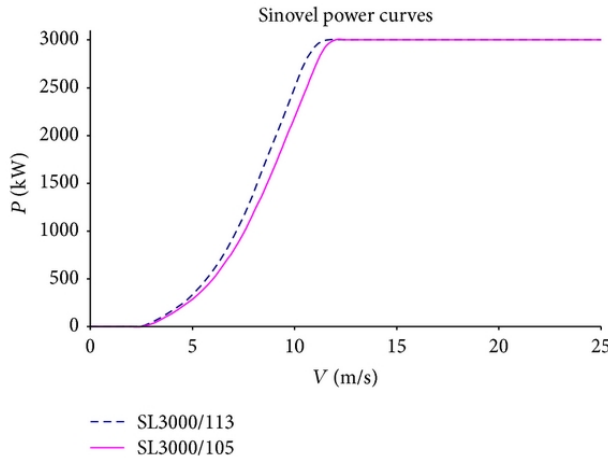

Fig 4: Comparison of Sinovel power curves

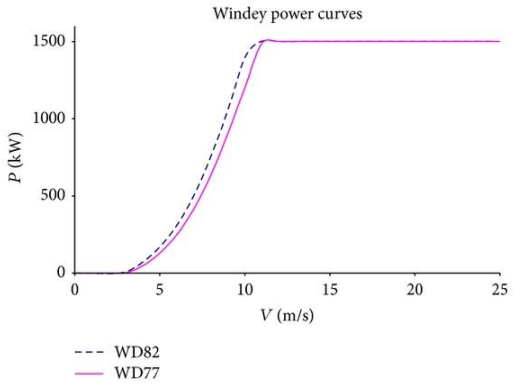

Fig 7 Comparison of Windey power curves.

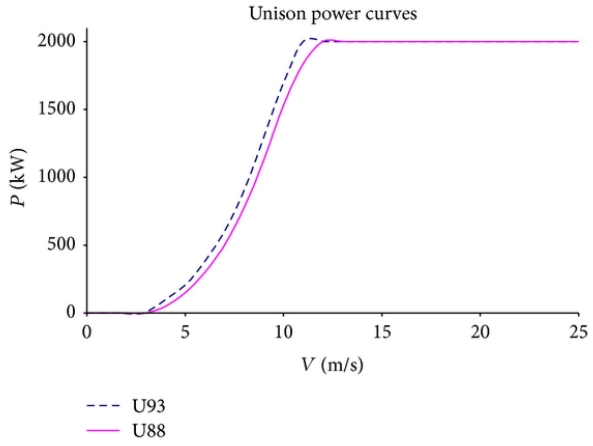

Fig 5 Comparison of Unison power curves.

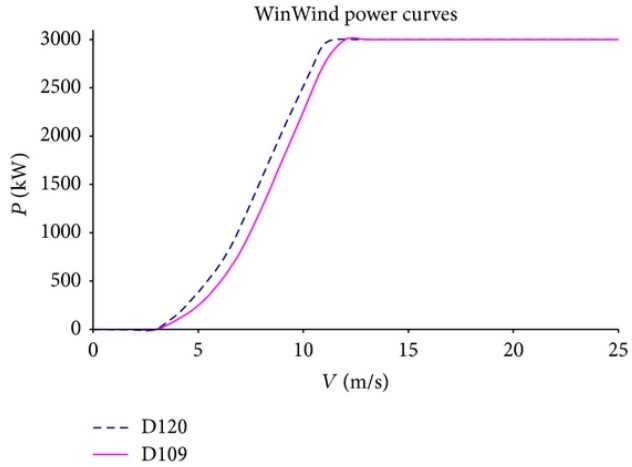

Fig 8 Comparison of WinWind power curves.

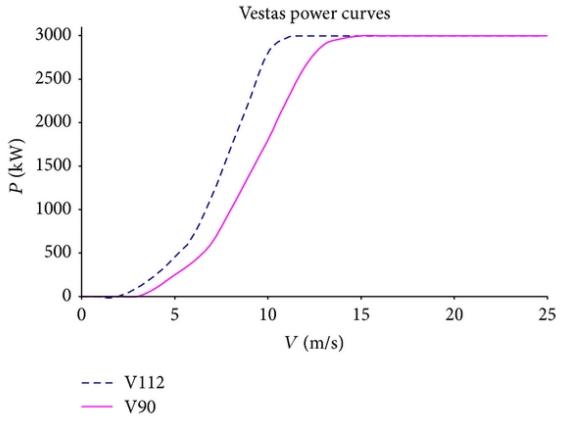

Fig 6 Comparison of Vestas power curves.

[4] FUTURE SCOPE AND CONCLUSION

Wind energy offers many advantages, which explains why it's one of the fastest-growing energy sources in the world. Research efforts are aimed at addressing the challenges to greater use of wind energy. Read on to learn more about the benefits of wind power and some of the challenges it is working to overcome.

Future scope of Wind Power

1. **It's a clean fuel source.** Wind energy doesn't pollute the air like power plants that rely on combustion of fossil fuels, such as coal or natural gas. Wind turbines don't

produce atmospheric emissions that cause acid rain or greenhouse gasses.

2. **Wind energy is a domestic source of energy.** The nation's wind supply is abundant: over the past 10 years, cumulative wind power capacity in the United States increased an average of 30% per year, outpacing the 28% growth rate in worldwide capacity.
3. **It's sustainable**. Wind is actually a form of solar energy; winds are caused by the heating of the atmosphere by the sun, the rotation of the earth, and the earth's surface irregularities. For as long as the sun shines and the wind blows, the energy produced can be harnessed to send power across the grid.
4. **Wind power is cost effective.** It is one of the lowest-priced renewable energy technologies available today, costing between four and six cents per kilowatt-hour, depending upon the wind resource and project financing of the particular project.

Wind turbines can be built on existing farms or ranches. This greatly benefits the economy in rural areas, where most of the best wind sites are found. Farmers and ranchers can continue to work the land because the wind turbines use only a fraction of the land. Wind power plant owners make rent payments to the farmer or rancher for the use of the land providing landowners with additional income.

[5] CONCLUSION

The effect of wind class in wind turbine energy production is examined for five different wind turbine manufacturers. For each manufacturer, two wind turbines with identical rated power and different wind turbine classes [IEC II and IEC III] are compared for both sites. technical characteristics of ten considered wind turbines. Five manufacturers are namely Sinovel, Unison, Vestas, Windey, and WinWind. study shows that six wind turbines have rated power of 3 MW, two of them have rated power 2 MW, and remaining two have rated power 1.5 MW. Wind turbines of class III have larger diameters compared to their corresponding wind turbines of class II. Moreover, with exception of Vestas, all wind turbines of same manufacturer have identical hub heights. In each diagram, better performance of class III wind turbines in low and medium wind speeds is obvious, especially in case of Vestas models, which also present greatest difference in rotor diameter [90 m for class II, 112 m for class III].

[6] References

1. A..D. Spera,*Wind turbine technology*, ASME press, London, 1994, p.7.

2. G. Boyle, *Renewable energy, power for a sustainable future*, Oxford University Press, Oxford, England, 2004, p. 244.

3. T. Ackerman, *Wind energy technology and current status, a review*, Elsevier science, 2000, p.322 (Accessed 22/01/2007).

4. K.T. Fung, R.L. Scheffler, J. Stolpe, *Wind energy—a utility perspective*, IEEE Trans Power Appar System, **Vol. 100**, 1981, p. 1176–82.

5. S. Ezio, C. Claudio, *Exploitation of wind as an energy source to meet the world's electricity demand*, Wind eng., **Vol. 74-76**, 1998, p. 375-87.

6. G.M. Goselin, *A review of wind energy technologies*, Renewable and sustainable energy reviews, **Vol. 11**, 2007, p.1118.

7. T. Ackerman, *Wind energy technology and current status, a review*, Elsevier science, 2000, p.349 (Accessed 22/01/2007).

8. Prehn Morten Sùrensen, *Learning curve: how is new energy technology costs reduced over time, Report of an IEA Workshop*, International Energy Agency, Paris, 1997.

9. T. Ackerman, *Wind energy technology and current status, a review*, Elsevier science, 2000, p.351 (Accessed 22/01/2007).

10. P.K.Chands, S.V. Tokekar, *Expert-based maintenance: a study of its effectiveness*, IEEE Trans Reliab, 1998, **Vol. 47**, p. 95-97.

11. W. Denson, *The history of reliability prediction, failure causes for electronic systems*, IEEE Trans Reliab, 1998, **Vol. 47**, p. 325.

12. P. Gipe, *Wind Power*, James & James, London, 2004, p. 85-88.

13. E. Hau, *Wind Turbines, fundamentals, technologies, application, economics*, Springer-verlag Berlin Heidelberg, 2000, p. 46.

14. A.D. Spera,*Wind turbine technology*, ASME press, London, 1994, p.50-61.

15. Danish Wind Industry Association, *Power control of wind turbines*, http://www.windpower.org/en/tour/wtrb/powerreg.htm (Accessed 20/1/07).

16. T. Ackerman, *Wind energy technology and current status, a review*, Elsevier science, 2000, p.331 (Accessed 22/01/2007).

17. A.D. Spera,*Wind turbine technology*, ASME press, London, 1994, p. 283.