2020 SPRING VIRTUAL LEARNING SERIES
Powering your knowledge online.

Reduce the Levelized Cost of Energy by Using Aerodynamic Flow Deflectors Upgrade: Field Test Results

A. VILLEGAS[1], F. J. DIEZ-GARIAS[1], C. SHOEMAKER[1] and L. KURTH[1]
1 XPEED Turbine Technology, Piscataway, NJ

XTT® Boost Your Wind Farm Energy Output

BACKGROUND

A new blade technology, called Aerodynamic Flow Deflectors (AFDs), makes wind turbines more efficient and reduces the levelized cost of energy (LCOE) significantly.

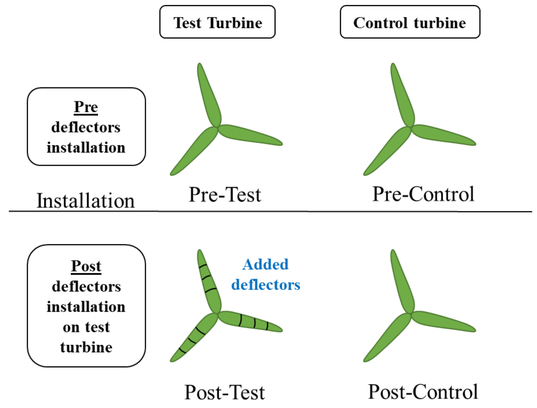
The technology is the outcome of 6 years of research and field testing funded by Rutgers University (NJ) and merit-based grants from the NSF SBIR Phases I and II.

The main benefit is the **improvement of the wind farm Annual Energy Production (AEP) by 2-4% while reducing the LCOE by 1-3%**

METHOD

- Last year, we showed 4 field tests results with an average **2-4% AEP increase** following the IEC 61400-12-1 (including a GE 1.5MW SLE at the NREL NWTC farm)
- This year, we show preliminary results from a side-by-side pilot at a wind farm with the same turbine model GE 1.5MW SLE. We compare three **power-vs-power methods** used in the industry to analyse AEP changes of turbine upgrades [1-3].
- Side-by-Side records power differences between Test Turbine and Control Turbine at each timestamp ($\Delta \boldsymbol{P} = \boldsymbol{P^{Test} - P^{Control}}$)

SIDE-BY-SIDE SETUP



j = bin number

$$\Delta P_{pre,j} = \overline{P_{pre}^{Test} - P_{pre}^{Control}}$$

$$\Delta P_{post,j} = \overline{P_{post}^{Test} - P_{post}^{Control}}$$

$$\Delta P_j = \Delta P_{post,j} - \Delta P_{pre,j}$$

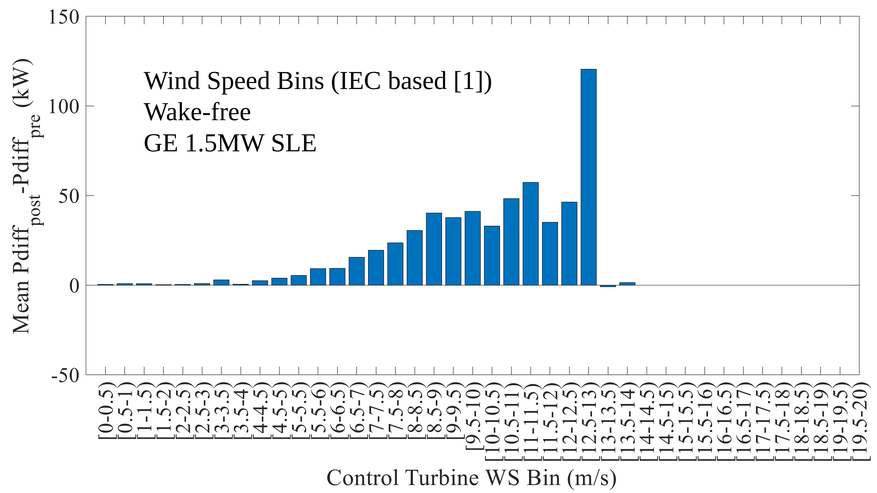
$$\Delta AEP = \sum_j \Delta P_j \cdot PDF_j \cdot 8760$$

$$\boldsymbol{\Delta AEP\% = \frac{\Delta AEP}{AEP_{ref}}}$$

WIND FARM PRELIMINARY RESULTS

(1-YEAR BASELINE AND 4-MONTH DEFLECTORS)

AEP % (10-minutes average data, Rayleigh 6.5m/s)	WD sectors filter On (wake-free)	WD sectors filter Off
1. Wind Speed Bins (IEC based [1])	3.50%	2.26%
2. Power Bins (SmartBlade based [2])	3.38%	2.09%
3. Power & Wind Dir. bins (WindGuard based [3])	2.12%	1.77%



CONCLUSIONS

- AFDs retrofitted to turbine blades can improve AEP significantly while reducing LCOE
- The three different side-by-side methods show similar results
- Wake-free results show higher AEP % increase compared to unfiltered sectors
- No significant power differences observed after rated power is reached

REFERENCES

[1] IEC, "Part 12-1: Power performance measurements of electricity producing wind turbines; IEC TC/SC 88" IEC 61400-12-1, 2005
[2] Hwangbo, Hoon, et al. "Quantifying the effect of vortex generator installation on wind power production: An academia-industry case study" Renewable Energy 113 (2017): 1589-1597.
[3] A. Albers, "Side-by-side testing" Nordic Wind Power Conferece, Oslo, 2014.

ACKNOWLEDGEMENTS

This material is based upon work supported by the National Science Foundation under Grant Number 1660224.

Meggitt for supporting manufacturing efforts

Aeolus for supporting installation efforts

CONTACT INFORMATION

Arturo Villegas (CEO)
arturo.villegas@xpeedturbinetechnology.com