Array Effects in Large Wind Farms

Cooperative Research and Development Final Report

CRADA Number: CRD-09-343

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In accordance with Requirements set forth in Article XI, A(3) of the CRADA document, this document is the final CRADA report, including a list of Subject Inventions, to be forwarded to the Office of Science and Technical Information as part of the commitment to the public to demonstrate results of federally funded research.

Parties to the Agreement: Trustees of Indiana University

CRADA Number: CRD-09-343

CRADA Title: Array Effects in Large Wind Farms

Joint Work Statement Funding Table Showing DOE Commitment:

Estimated Costs	NREL Shared Resources
Year 1	$ 30,000.00
Year 2	$ 30,000.00
Year 3	$ 30,000.00
Year 4	$ 30,000.00
TOTALS	$ 120,000.00

Abstract of CRADA Work:

The effects of wind turbine wakes within operating wind farms have a substantial impact on the overall energy production from the farm. The current generation of models drastically underpredicts the impact of these wakes leading to non-conservative estimates of energy capture and financial losses to wind farm operators and developers. To improve these models, detailed research of operating wind farms is necessary. Rebecca Barthelmie of Indiana University (now Cornell University) is a world leader in wind farm wakes effects and would like to partner with NREL to help improve wind farm modeling by gathering additional wind farm data, developing better models, and increasing collaboration with European researchers working in the same area. This is currently an active area of research at NREL and the capabilities of both parties should mesh nicely.

Summary of Research Results:

The work accomplished under this agreement included an examination of wake merging using different models from analytical to computationally intensive large eddy simulations. Predictions of wake losses within wind farms were compared to publicly available data from offshore wind farms in Europe. It was discovered that when the flow is directed down the row, the analytical models tended to overpredict the wake loss, while the large eddy simulations tended to

underpredict. When the flow was skewed from the row, the analytical models overpredicted the wake expansion. The results from this work were presented at international conferences focused on wind energy and atmospheric science. A project was funded by DoE (SOWFA) through this work. Field work included student exchange when the scanning lidar was operated at NREL (in conjunction with NREL scientists) from which a paper describing the use of arc scans to measure wind speeds was published in the Journal of Atmospheric and Oceanic Technology in 2014. A second student intern worked with NREL on wake characteristics derived from LES wake modeling from which a paper was submitted to Wind Energy in 2015.

Subject Inventions Listing:

There were no inventions created during the course of this CRADA

Report Date:

23 February 2016

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