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Physical Model Study of the Fully Developed Wind Turbine Array Boundary Layer in the UNH Flow Physics Facility JOHN TURNER, MARTIN WOSNIK, University of New Hampshire — Results from an experimental study of an array of up to 100 model wind turbines with 0.25 m diameter are reported. The study was conducted in the UNH Flow Physics Facility (FPF), which has test section dimensions of 6.0 m wide, 2.7 m high and 72.0 m long. For a given configuration (spacing, initial conditions, etc.), the model wind farm reaches a fully developed condition, in which turbulence statistics remain the same from one row to the next within and above the wind turbine array. Of interest is the transport of kinetic energy within the wind turbine array boundary layer (WTABL). Model wind farms of up to 20 rows are possible in the FPF at the wind turbine scale used. The present studies in the FPF are able to achieve the fully developed WTABL condition, which can provide valuable insight to the optimization of wind farm energy production. The FPF can achieve a boundary layer height on the order of 1 m at the beginning of the wind turbine array. The wind turbine array was constructed of porous disks, which where drag (thrust) matched to wind turbines at typical operating conditions and therefore act as momentum sinks similar to wind turbines. The flow in the WTABL was measured with constant temperature anemometry using an X-wire.

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