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Boundary-layer flow and power output in large wind farms during transition from neutral to stable conditions[1] DRIES ALLAERTS, JOHAN MEYERS, KU Leuven, Mechanical Engineering, Celestijnenlaan 300A, B3001 Leuven, Belgium — In wind farms, power deficits are directly related to ambient turbulence levels. Power deficits will therefore increase during the transition from a daytime, conventionally neutral boundary layer (CNBL) to the stable boundary layer (SBL) at night. Besides turbulent decay, a multitude of effects occurs during this transition. For instance, low-level jets may cause strong winds at high elevations, while the velocity near the surface generally decreases. Consequently, Coriolis forces induce a change in wind direction, which alters the apparent wind-farm layout in streamwise direction. In this study, we perform LES of a large onshore wind farm in the late-afternoon transition from an equilibrium CNBL to a surface-cooled SBL. The results of two different cooling rates are compared with the wind-farm performance in the CNBL. The power output decrease during the transition, with faster decrease for stronger surface cooling. However, the initial decrease is dominated by the reduction in wind speed, and the relative power deficits do not increase. Further, considerable wake deflection occurs, and a spatially heterogeneous distribution of temperature and heat flux is observed.

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