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SAND2019-9115C

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-title-

Flow Instabilities during High-performance Operation of a Wind Energy Harvester with No External Moving Parts

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-abstract-

A novel wind energy harvester with no external moving parts is demonstrated at one-third scale (0.5-meter chord) in wind tunnel tests. The device uses mirrored airfoil-pairs to create suction. This pulls air out from ducts internal to the foils, through air-jet orifices on the low-pressure sides of the foils, and into the external incident wind. Power is transmitted pneumatically through the center of the foils to an internal turbine-generator. In the high-performance operating mode at high angle-of-attack, a mechanical power transmission of nearly one-half of the Betz limit is achieved. However, this high angle-of-attack configuration is susceptible to aero-acoustic instabilities which can diminish the performance to as low as one-sixth of the Betz limit. These instabilities are investigated here for a configuration with all air-jets covered. Pressure measurements are made on the low-pressure sides of the foils and the break in symmetry associated with the instability is documented. Particle image velocimetry is used to characterize the flow field before and after onset of the instability.

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