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Wake dynamics behind two closely spaced vertical axis turbines CATHERINE WILSON, VALENTINE MUHAWENIMANA, STEPHANIE MUELLER, PABLO OURO, Cardiff University, ALDO BENAVIDES, CARLOS DUQUE, Universidad Nacional de Colombia, CARDIFF UNIVERSITY COLLABORATION, UNIVERSITY OF WARWICK COLLABORATION — The technology for harnessing kinetic energy from rivers via turbines has evolved at a slower pace than in wind or tidal environments. Widely adopted in these fields due to their high energy conversion rates, horizontal axis turbines operate at high rotational speeds in high velocity environments, which can drastically impact ecosystems. Alternatively, vertical axis turbines are designed to operate at lower rotational speeds, and with the advantage of their rectangular cross-section, efficiently extract kinetic energy from river streams while reducing environmental impact. This research tested two small-scale vertical axis turbines in a hydraulic flume, measuring their wakes up to 10 diameters downstream and across the flume width. The three-bladed devices rotated at a constant speed equivalent to their optimum energy conversion rate. From ADV velocity measurements, results in terms of mean velocities and turbulence fluctuations show that the individual wakes merge into a single low-velocity wake and this directly affects the flow processes involved. Flow measurements also captured the tip vortices developed during the upstroke and downstroke rotation of the turbines. Comparisons of these wake dynamics were analysed for two lateral spacings of 1.5 and 2.0 turbine diameters.

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