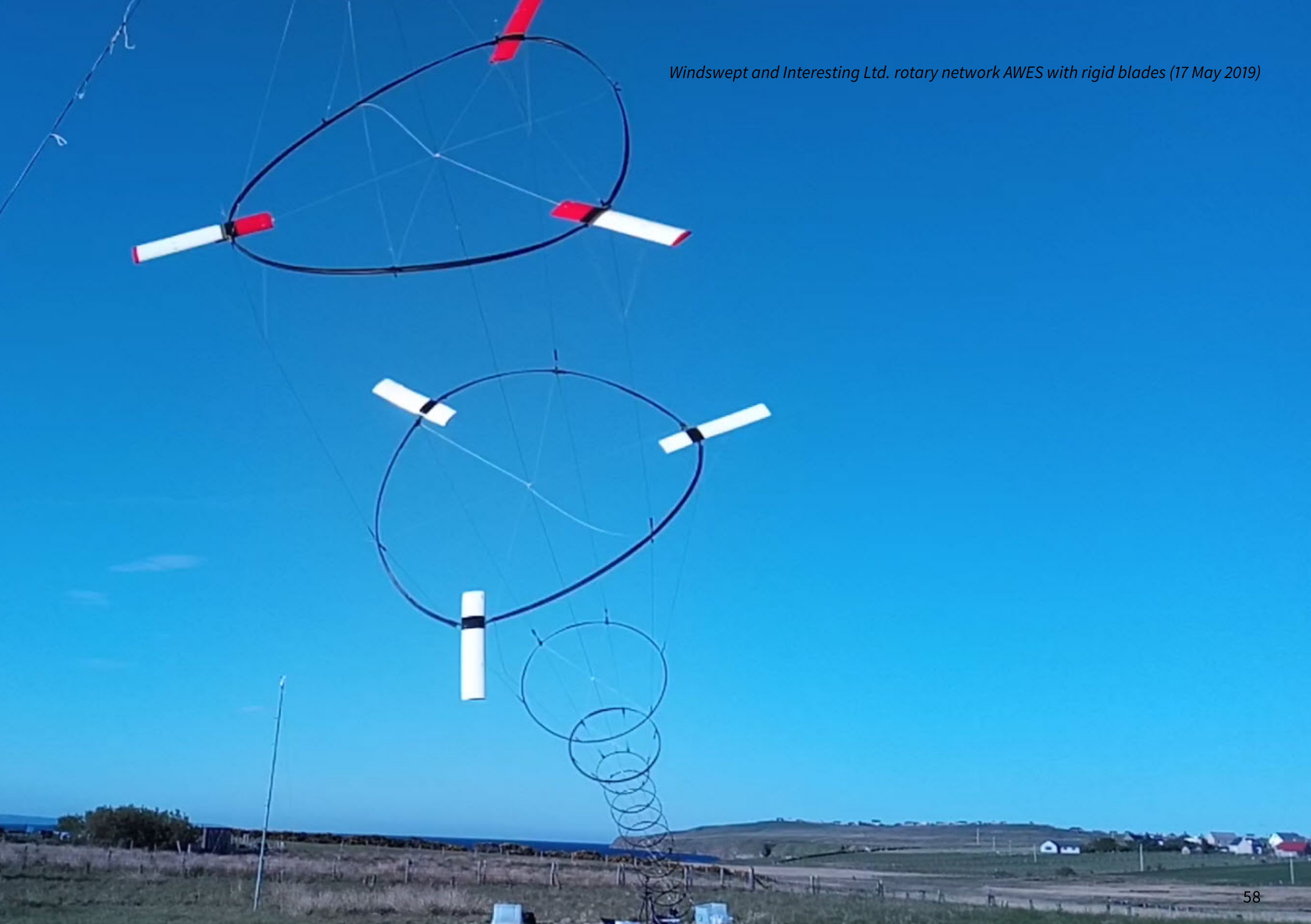

Windswept and Interesting Ltd. rotary network AWES with rigid blades (17 May 2019)

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Practical Experimentation on Rotary Network AWES

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Simple rigid blades can be sewn together and flown as a networked autogyro kite turbine. Torque from the mechanical drag mode turbine, can be continuously transmitted to a ground-based generator. Torque transmission is limited to within the safe working limits of tensile tethers held apart by a succession of rings. Greater tension, diameter or number of lines allows more torque to be safely transmitted. The simplicity of design and build enables experimentation on modularly scalable system architectures from a small facility. Simulation data (and flying form) shows that torque transmitting kite networks, don't need to rely on rigid ring structure, when the kites are sufficiently banked.

Kite turbine system portability and operation was tested when a scout troupe took an older parafoil kite based turbine to an international jamboree. Analysis by Oliver Tulloch suggested, rigid rotor blades would have a higher power coefficient. Testing proved Oliver correct, the rigid blade rotors, showed even higher efficiency than predicted. The single rigid ring system, (Shown as lower white ring in picture opposite page) with flying weight under 2kg, output over 1.5 kW, flying only 4 m above the ground in 10 m/s wind. When disassembled, the rigid kite ring will still easily fit inside the back of a car.

Stacking the kite rings increases system efficiency by improving kite area to line drag area. Line drag effects can be further mitigated with fairing on the short section network lines, which have near constant inflow. Stacked kite ring turbines tend to be more stable in flight but setting them up to launch is a little harder. The current launch method involves laying the rings out on the ground, attaching them, launching a lifting kite, then hoisting the top of the turbine stack into the air by paying out a back anchor line. Setting the rigging tension correctly by adjusting the height, where the lifting kite line attaches to the top of the turbine stack, still takes practice.

The safety of network architectures was dramatically demonstrated when 7 of 8 tethers were broken yet no part broke away from anchoring. The turbines have continued to work, despite various and multiple line breakages, albeit with deteriorated performance. The line longevity is good as none of the lines abrade on running gear. Significant rotational forces can throw components from a rotor. The two stiffening spar tubes are tied through to stop centrifugal forces causing slippage. We will present advantages of network kites and results from campaigns and simulations. Kite Network turbines work deep in the power zone and have a good propensity for failsafe scaling. We are developing a series of scaled development proposals 5 kW(3x3), 10 kW, 7x5 kW(7x3x3), 50 kW, 7x10 kW & 100 kW. We hope to share some practical lessons and a physical demonstrator model at AWEC 2019 too.

References:

[1] Read, R.: Kite Networks for Harvesting Wind Energy. Airborne Wind Energy Advances in Technology Development and Research. Singapore: Springer, pp. 515-537 (2018). https://doi.org/10.1007/978-981-10-1947-0_21