The Daedalus Project: AWE Tether Engineering Method Substantiated

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The goal of the Daedalus project [1] at Ampyx Power is to be able to optimize the interaction between tether design and aircraft design of a megawatt pumping AWE system (AP4) towards lowest levelized cost of energy. For this purpose a full-scale tether test machine is designed and built capable of simulating relevant AWE flight conditions. The machine is now available for testing and first results are evaluated.

The Daedalus test set-up is such that long lengths of tethers can be tested covering the full stroke of a power pumping cycle. This is facilitated by a winch with a big drum where the tether runs off the drum at the top towards a remote sheave (about 20 m further) and back onto the drum at the bottom. The load is applied to the remote sheave by a tension winch. The maximum operational load is 40 tons. Several test scenarios are available to the machine. Simple Bending Over Sheave (CBOS+) at constant load, CBOS High Speed and Cyclic Operational Wear over Sheave (COWS). The sizes of the sheave can be varied between sheave to rope diameter (D/d) ratios of 20 and 40. The sheave can be blocked to evaluate abrasion as a result of possible inertia effects. Current tether samples are Dyneema® DM20 based ropes in 2 constructions, a 12 strand circular braid as well as a 5 strand flat braid with (equivalent) diameters of 21 and 40 mm. The breaking strength range of these ropes is between 40 and 160 tons. A special tether lifetime tracking (TLT) system has been developed to track the damage induced by means of bending and creep at every meter of the rope sample. Ropes are tested to failure as well as damaged to a level that is varying over the full length of the stroke, with a wear distribution over the stroke that is representative of an actual tether of a pumping AWE system. A residual break test will give a correlation between test settings, damage attribution by the TLT and the residual breaking strength, to validate the safe-life models developed. In the end the results will lead to an engineering method for tether design being optimized towards local weather conditions, plane behaviour and desired operational lifetime. First test results will be shared and next steps described.

Daedalus tether test machine.

References:

[1] Supported by RVO/TKI Wind op Zee, Interreg NWE (MegaAWE)