Hovering flight test of the 600 kW energy kite

Transportation of the 600 kW energy kite to the test location (28 October 2016)

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Progress and Challenges in Airborne Wind Energy

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How our electricity is generated has a big impact on our planet, which is why many of us at X are exploring moonshots in clean, renewable energy sources. The Makani team is focused on unlocking the potential of wind energy. Currently only 4% of the world's electricity comes from the wind, but easier access to strong, steady winds in more places on the globe could push that number far higher.

In my Keynote address to the 2010 Airborne Wind Energy Conference [1] I highlighted a number of engineering challenges that the nascent industry faced, including: safety and reliability, bringing a rigorous risk management approach to product development and operation, the need for design standards and certification, the need for validated dynamic simulations, the definition of appropriate design load cases and safety margins, and the importance of a comprehensive testing program. Considerable progress has been made in the last 7 years, and this progress will be illustrated using examples from the development of Makani's M600 energy kite system.

In addition to engineering challenges, airborne wind energy technologies face tremendous business challenges. Renewable energy systems must demonstrate long-term power generation performance, and low and predictable operations and maintenance costs to justify the large upfront investment that is required to deploy these systems. Competing renewable energy technologies have accumulated many decades of operational experience that has established that their performance and reliability are "bankable". The long, difficult and expensive effort needed to demonstrate bankable reliability and performance for airborne wind energy system largely lies ahead of the new industry. The presentation will review how adjacent industries have successfully overcome these hurdles, and how these examples can serve as models for the eventual commercial success of airborne wind energy systems.

Finally, the technology used in Makani's M600 system will be described, and I will provide an update on the overall progress of the project. The system is designed to produce 600 kW of electricity. Our largest kite to date, it has a wingspan of 26 m, and has eight onboard rotors that are each 2.3 m in diameter. For comparison, our previous prototype, Wing 7, was a 20 kW system with a 8m wingspan and with four rotors 0.7 m in diameter. Key lessons learned in the M600 project and planned future work will be described.

References:

[1] Felker, F.: Engineering Challenges of Airborne Wind Technology. Presented at the Airborne Wind Energy Conference 2010, Pasadena, CA, USA., 28–29 September 2010. https://www.nrel.gov/docs/fy10osti/49409.pdf