Department of Mechanical and Materials Engineering

SENIOR DESIGN ORGANIZATION SYNOPSIS – FALL 2013

WIND TURBINE MODEL FOR POWER GENERATION AND HURRICANE WIND MITIGATION

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Hurricane season represents a very important phenomenon for South Florida and the neighboring regions. Hurricanes come accompanied by severe rain as well as very strong winds. There is an imperative need for engineering solutions to improve the resistance of houses to strong winds that destroy them. The vacuum effect produced by these winds is the main reason why roofs of houses lift up during a hurricane. This project aims to address this problem by implementing a new device that will mitigate this uplift effect.

The tremendous pressure difference between the upstream and downstream conditions of the flow of air during a hurricane causes the lifting force that detaches the roof from the rest of the structure. This project proposes to develop a horizontal wind turbine that will be installed at the edge of a building's roof and will serve to mitigate the effects of the pressure gradient produced by the flow of air at elevated speeds. Also, this proposed design will produce electricity by harvesting the kinetic energy carried by the fluid during the hurricane as well as under normal weather conditions.

The design phase of this revolutionary device considers variables such as diameter to length ratio, number of blades, shape of the blades, angle of twist, material used for prototype construction, and optimal location of the device relative to the structure's roof. Another aspect that will be investigated is the shape of the roof. Various scenarios of roof shapes will be considered during the design and optimization process. To investigate the viability of this system, a Computational Fluid Dynamic (CFD) study will be performed on the proposed design. In addition, with the obtained pressure readings, an estimated power generation capacity of the model will be assessed. After the CFD study is concluded, experimental trials of the turbine model will be conducted in Florida International University's Wall of Wind to validate the results of this analysis.