### Accepted Manuscript

Effect of Airfoil Profile on Aerodynamic Performance and Economic Assessment of H-rotor Vertical Axis Wind Turbines

Mohammad Jafari, Alireza Razavi, Mojtaba Mirhosseini

PII: S0360-5442(18)31888-7

DOI: 10.1016/j.energy.2018.09.124

Reference: EGY 13818

To appear in: Energy

Received Date: 17 January 2018

Accepted Date: 18 September 2018

Please cite this article as: Mohammad Jafari, Alireza Razavi, Mojtaba Mirhosseini, Effect of Airfoil Profile on Aerodynamic Performance and Economic Assessment of H-rotor Vertical Axis Wind Turbines, *Energy* (2018), doi: 10.1016/j.energy.2018.09.124

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.



#### ACCEPTED MANUSCRIPT

# Effect of Airfoil Profile on Aerodynamic Performance and Economic Assessment of H-rotor Vertical Axis Wind Turbines

Mohammad Jafari a, Alireza Razavi a, Mojtaba Mirhosseini b,\*

<sup>a</sup> Aerospace Engineering Department, Iowa State University, Ames, IA 50011, USA <sup>b</sup> Department of Energy Technology, Aalborg University, Pontoppidanstraede 111, 9220 Aalborg East, Denmark

\*Corresponding author: seh@et.aau.dk

#### 7 ABSTRACT

3

4 5

6

This research focuses on the effects of the asymmetric airfoil profiles on aerodynamic performance and 8 9 economic evolution of a vertical axis wind turbine (VAWT) at different blade heights, solidities, and tip 10 speed ratios (TSR or  $\lambda$ ). The aerodynamic performance of six asymmetric airfoils, S809, S814, RISØ-A1-24, Du 93-W-210, FFA-W3-241, and FX66-S196-V1, was calculated using double multiple-stream tube 11 12 (DMST) theory and blade element methods for determination of their performance for tip speed ratios from 1 to 12, and solidities of 0.2 to 0.6, were considered for this study. All calculations focused on the 13 Khaf area (rural zone) in Iran and considered two heights: 10 m and 40 m. To verify the performance of 14 the developed code, results were compared with experimental power coefficient data for NACA0012 15 airfoil. For FFA-W3-241 airfoil, maximum power coefficient was obtained at solidity of 0.5 and tip-speed 16 ratio of 4. This aerodynamic excellence resulted in 22.4% and 21.9% increase in annual energy production 17 at hub heights (h) of 10 m and 40 m, respectively, while keeping the total investment costs constant. 18 Moreover, the ratio of wind-generated electric power sales to the total investment cost was found to be 19 4.33 (0.15/0.0346) for 15 years of operation. 20

21

Keywords: H-type Vertical Axis Wind Turbine; Double Multiple Stream Tube (DMST) Model; Blade Element
Momentum Theory; Airfoil Selection; Power Generation; Economic Evaluation.

24

25

#### 26 1. Introduction

27

National economic growth is highly dependent on energy consumption. Until 1973 and oil price crisis, fossil fuels were the main source of energy. In 1974, the U.S. government initiated a project with industry to develop commercial wind turbines. Introduction of the MOD-5B was one outcome of the project which was the largest single rotor wind turbine in 1987, with a rotor span of about 100 m and a power capacity of 3.2 MW. At the same time, Denmark began the development of multi-megawatt wind turbines and

Download English Version:

## https://daneshyari.com/en/article/11026440

Download Persian Version:

https://daneshyari.com/article/11026440

Daneshyari.com