The Interception of Wind Turbine Lightning Receptor Type and Radius to Electrical Field

Samer. S. Wahdain[1,a)], A. I. Mohamed[1,b)], ZA Noorden[2,c)], MRM Esa[2,d)]

[1]*Faculty of Electrical and Electronic Engineering, University Malaysia Pahang, Pekan Pahang, Malaysia*
[2]*School of Electrical Engineering, University Technology Malaysia, Johor, Malaysia*

[a)] *samuurr@gmail.com*
[b)] *Corresponding author: amirizzani@ump.edu.my*
[c)] *zulkarnain-an@utm.my*
[d)] *monariza@utm.my*

Abstract. Wind turbines are considered one of the tallest buildings vulnerable to lightning strikes as they lack a protection system for large-scale carbon-fibre epoxy composite structures. Blades are more affected by lightning due to their large scale, which is the highest point in wind turbine structure. Knowledge of cloud-to-ground (CG) lightning, lightning protection system (LPS), electrical field relation and receptor configuration are explained. A design from an actual wind turbine blade is used to study the effect of lightning. The receptor plays an essential role in determining the efficiency of (LPS). To investigate the impact of receptors with different shapes and sizes, two different types of lightning protection receptors are used to perform their effect on lightning. Three different radius of lightning copper receptor disks, 0.1m, 0.2m and 0.4m, have been tested. A triangle with a head to the downside simulates the lightning terminal. This paper is aimed to study and analyze the most suitable lightning protection for wind turbine blades to suggest the best parameters for receptor type and size. The electromagnetic Finite Element Method simulation recommends the minimum and maximum electric field that builds up around receptors, which has been used to determine the correct size and forms of receptors. Results from the lighting strike Simulation 0.1m receptor gives the highest value of electrical field interception 56.3MV/m compared with larger size receptor 0.4m with 18.7MV/m. This research revealed the effectiveness of different types of lightning receptors and the effect of the receptor's radius, which will offer better protection to the wind turbine

Key-Words: Finit Element Method, Wind turbine lighting protection, Receptors, Lightning.

INTRODUCTION

Wind energy is one of the green energy sources that refer to the process of capturing the kinetic Energy from the flow of wind that occurs naturally in the atmosphere to create energy [1]–[3]. However, to prospects for the growing demand for wind turbines, the capability of wind generations has been increasing, and the most popular one is 1000-2000 kW. A follow-up with this increase in the generators encrypts the entire turbine size (a tubular pylon supports a hub with three rotor blades attached and a "nacelle" that houses the shaft, gearbox, generator, and controls). Wind turbines are up to 120 meters from the earth's surface [2], [4], [5]. Therefore, the wind turbine can be exposed to thunderstorms (lightning strikes) due to their height, location, weather, and terrine, as typically installed on mountains, offshore, and other places.

A lightning protection system is more important than that for a small size [5]. Lightning risks to wind turbines vary by geographic area, time of year and turbine location. There is a risk of lightning at every wind farm. Over a few decades, many studies have been done on wind turbine lightning protection (LPS). Most of them were focused on modelling lightning attachment on a wind turbine with different sizes and location receptors. Yokoyama, 2013) represented that using a receptor was not perfect compared to a blade sample covered with a cap conductor at the

The 5th International Conference on Automotive Innovation and Green Energy Vehicle
AIP Conf. Proc. 2998, 070003-1–070003-11; https://doi.org/10.1063/5.0188782
Published by AIP Publishing. 978-0-7354-4793-6/$30.00