INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study : Ph.D.

Thesis Title: **Modeling and Analysis of Wind Energy Conversion Systems and its Impact on Power System**

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Thesis Submitted to the Department/ Center : **EEE**

Date of completion of Thesis Viva-Voce Exam : **30/10/2023**

Key words for description of Thesis Work : **Blade element momentum (BEM) theory, bridge-type fault current limiter (BTFCL), fault ride-through (FRT) capability, and wind energy.**

SHORT ABSTRACT

In this thesis, the aerodynamic characteristics and the flow mechanism are investigated on two-dimensional (2-D) airfoils at different angles of attack and changing wind speed. This work aims to calculate the optimum angle of attack to achieve the desired characteristics of the wind turbine. Here, the aerodynamic simulations are carried out using the computational fluid dynamics (CFD) techniques based on the finite-volume method. Since, the computational results take significant time, hence, using the steady-state results obtained from BEM theory and computational results are utilized to propose a model which includes an equivalent second-order transfer function (TF) to estimate the aerodynamic performances of the wind turbine. The wind power generation is observing a significant use of a doubly-fed induction generator (DFIG) due to its improved efficiency, but the converter used in the configuration is sensitive to the presence of a fault in the grid. This thesis presents a fault ride-through (FRT) configuration, which includes a thyristor-based bridge-type non-superconducting fault current limiter (ThyBT-NSFCL) augmented with a buck converter. Moreover, wind energy-based distributed generation (DG) plays a vital role in developing a sustainable grid. Due to the intermittent nature of wind energy sources, the power output also poses potential technical challenges to the grid and utilities. The technical challenges in the power system are the power quality issues such as voltage flicker, voltage sag, and swell of the distributed network. To study the influence of wind energy integration into the network, this thesis has utilized a modified distribution network of IIT Guwahati (MDN-IITG). Finally, the FRT capability of the wind generator is observed under the presence of FACTS devices in the system. This thesis includes a study on the impact of wind power penetration on the stability of the reduced North Eastern Regional Electricity Board (NEREB). The effectiveness of the DFIG system with a control system is tested and validated on the reduced North Eastern Regional Electricity Board (NEREB) 29-bus Indian power system. The simulation results reviles that after integration of the wind turbine results in poor damping of the system. But there is a significant improvement in the damping if the DFIG is integrated with the fault ride-through (FRT) devices.