SMALL-SIGNAL STABILITY ASSESSMENT USING A DYNAMIC PHASOR APPROACH: A CASE STUDY OF A 2MVA WIND POWER PLANT

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DECLARATION

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Dr. W. D. Prasad Date:

DEDICATION

This work is dedicated to my beloved parents, Mr: Samarapala Kahawidane and Mrs: Chandra Piyawathi.

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Abstract

Due to the technical development, support from the green energy enthusiasts and relative cost attractiveness wind energy harvesting has turn into one of the most popular renewable energy sources nowadays. When considered together with wind power plants, other power plants and transmission lines; power system has become a dynamic system which includes non-linear elements. Evaluating non-linear system with linearized method may not be sufficient to evaluate the system. Hence, advanced linear mathematical model is needed to study the wind plants connected to the grid and its oscillations. In this research, a linearized model developed with dynamic phasor approach combined with conventional small signal stability analysis is presented to analyze wind power system. The model developed is compatible with type 4 wind power plants in any capacity and can be adopted in any power system where system specifications are known.

With the help of 2MVA test system; model validation, stability analysis and a sensitivity analysis using participation factors will be carried out in order to identify dominant oscillations introduced to the grid from the plant.

Keywords: wind turbines, small signal stability analysis, dynamic phasors, linearized model, model validation, sensitivity analysis, participation factors

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List of Abbreviations

Abbreviation	Description
NE	North East
SW	South West
CEB	Ceylon Electricity Board
NREL	National Renewable Energy Laboratory
SEA	Sustainable Energy Authority
ADB	Asian Development Bank
DFIG	Doubly-Fed Induction Generators
SSI	Sub-Synchronous Interaction
VSC	Voltage Source Converter
PMSG	Permanent Magnet Synchronous Generator
GSC	Generator Side Converter
VSI	Voltage Source Inverter
TSR	Tip Speed Ratio
PWM	Pulse-Width Modulation
MPPT	Maximum Power Point Tracking
IGBT	Insulated-Gate Bipolar Transistor