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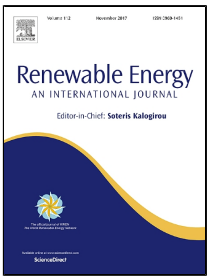

An analytical study for low voltage ride through of the brushless doubly-fed induction generator during asymmetrical voltage dips

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An analytical study for low voltage ride through of the brushless doubly-fed induction generator during asymmetrical voltage dips

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***Abstract*:** The Brushless Doubly-fed Induction Generator (BDFIG) has high potential for wind energy systems, especially for offshore applications where minimum maintenance is vital. The machine low voltage ride through (LVRT) capability in the light of current grid code requirements was investigated using a precise dynamic model. This is particularly important for future multi- MW BDFIGs.
This paper shows the necessity for improvements of the BDFIG LVRT capability with presenting a comprehensive analytical study during asymmetrical voltage dips. Analytical studies are conducted to extract a more precise equivalent circuit model of the BDFIG used for analyzing machine dynamic behavior under various fault conditions. In addition, a comparison between different voltage dips is performed to identify critical operating points for LVRT assessment. The results of the study are verified by coupled-circuit model, simulated in MATLAB/Simulink for a BDFIG prototype.

Index Terms: Brushless doubly fed induction generator (BDFIG), ride-through, coupled circuit model, asymmetrical voltage dips.

NOMENCLATURE

Vectors and Symbols

I, V, λ	Current, Voltage, Flux linkage
R,L,M	Resistance, Self, Mutual inductance
t, f, ω	Time, frequency, angular speed
RW, PW,CW	Rotor, Power, control windings
p,N	The number of Pole pairs, nested loops
M_{1r}, M_{2r}	Mutual inductance of PW,CW and rotor
R_2', L_2'	Transient resistance, inductance of CW
EMF.MMF	Electro, Magneto Motive Force
σ	damping coefficient of PW flux
Ph-G	Phase to ground voltage dip
Ph-Ph-G	Phase to Phase to Ground voltage dip
Ph-Ph	Phase to Phase voltage dip
P	Voltage dip level

Superscripts

1,2	PW, CW reference frame
*	Conjugation operator

Subscripts

1,2,r	PW, CW, rotor
p, n, z	Positive, negative and zero sequence
Pre, f	Refer to pre-fault, during fault value of variable

1. INTRODUCTION

Renewable energy technologies offer the promise of abundant energy gathered from self-renewing resources such as the sun, wind and biomass [1]. Among these, wind energy guarantees low pollution and operational costs and most of the installed wind turbines are doubly-fed induction generators (DFIG) [2]. Using a DFIG and a fractionally rated power electronics converter gives variable speed operation with a low cost drive train. As energy policy organizations have allocated a considerable quota of wind energy generation to offshore wind farms [3], the absence of slip rings and brushes in the brushless DFIG (BDFIG) is an