Paris Session 2022

Short circuit analysis of a Doubly Fed Induction Generator and their Impact on Generator Circuit Breakers

A3 – PS1, Paper No: 10805

Q:1 Paper 10805 describes that the degree of asymmetry of fault current in a DFIG system can be suppressed by converter control and optimized crowbar resistance. If sufficient suppression is expected, can the test duty of delayed current zero in IEC/IEEE 62271-37-013, Annex K be omitted?

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- *Test duty of delayed current zero in IEC/IEEE 62271-37-013*
  - Test duties 5, 6A & 6B are mandatory type tests that verifies the GCB's capability of interrupting delayed current zeros (DCZ).
  - Since the occurrence of DCZ is possible to any synchronous machine depending on the machine parameters, these test duties must be part of the standard and cannot be omitted.

Table 22 – Test-duties to demonstrate the generator-source short-circuit making and breaking current capability for three-phase tests

Test- duty [a,b,c]	Operating sequence	Applied voltage	Making current	Generator-source short-circuit breaking current at contact separation		Power-frequency recovery voltage [n]
				Magnitude	Degree of asymmetry	
3 [d]	C + 0,25 s	$U_r/\sqrt{3}$	I_{MC}	–	–	–
4	$C_{no\text{-}load}O_{sym}$ and $C_{no\text{-}load}O_{sym}$	–	–	I_{scg}	≤ 20 %	$U_r/\sqrt{3}$
5 [f, h, j, m]	$C_{no\text{-}load}O_{asym}$	–	–	I_{scg}	110 % [g]	$U_r/\sqrt{3}$ [e]
6A [f, i, k, m]	$C_{no\text{-}load}O_{asym}$	–	–	$0{,}74I_{scg}$	130 % [g]	$U_r/\sqrt{3}$ [e]
6B [f, h, l, m]	$C_{no\text{-}load}O_{asym}$	–	–	I_{scg}	130 % [g]	$U_r/\sqrt{3}$ [e]

Annex K. Requirements for doubly-fed induction machines (DFIMs) applications

- This Annex in IEC/IEEE 62271-37-013 describes the typical characteristics of the DFIM. However no detailed description of short circuit behaviour of this machine is given.

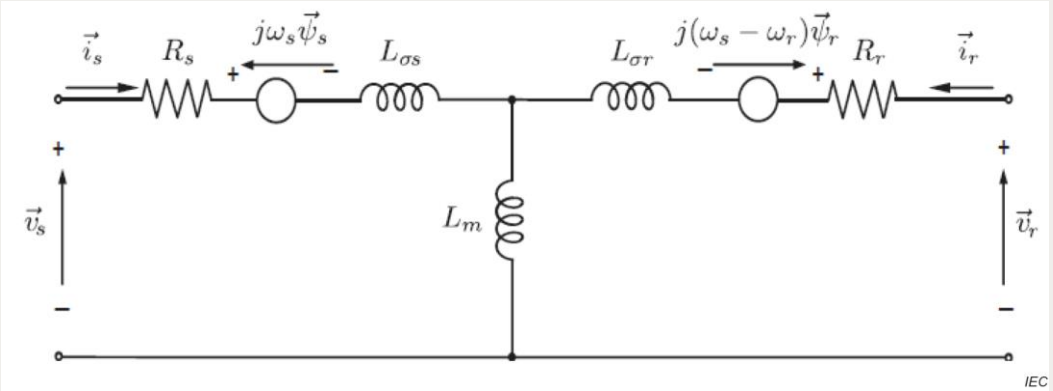

Figure K.1 – Equivalent circuit of a DFIM

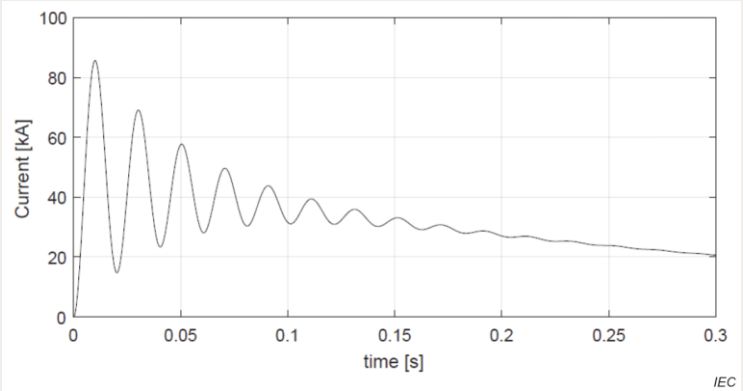

Figure K.2 – Example of influence of crowbar resistor on generator-source short-circuit current

- Authors intention is not to omit this Annex in IEC/IEEE 62271-37-013. But more detailed explanation is necessary in relation the figures K.1 & K.2.
  - Mentioning of crowbar resistor is missing in K.1 and also formula of converting the crowbar resistance from rotor side to stator side while analysing short circuit behaviour on stator side. This is given in detail in paper 10805.
  - Machine details used to generate figure K.2 is missing as well. In our opinion this curve is only possible for very high crowbar resistance values (~ 100 mOhms) which is not possible in practice due to the fact that such high resistance can create a higher voltage drop across the converter which can damage it.

Key Message: Annex K needs to be further elaborated with more details.

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