Short Circuit Fault Simulations in an HTS Wind Generator with Different Mechanical Conditions

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Introduction

1) Performances of a 2.5 MW HTS wind generator under short circuit fault conditions are studies by coupling finite element method (FEM) model and equivalent circuit model.

2) This study aims to find the influence of different mechanical conditions on simulation results of fault model, and provides a criterion to set the mechanical conditions.

3) Three different methods are used to set the mechanical conditions: constant rotation speed method, constant torque method and constant power method.

4) The influence of moment of inertia on field current is researched to find a way to protect the HTS winding during fault.

Three methods

1) Constant rotation speed method
   The rotor rotates at the rated speed constantly after the fault occurs.

2) Constant torque method
   Considering rotation speed variation, the governing equation is:
   \[ T_m - T_e = J \frac{d\omega}{dt} \]
   where \( T_m \) stays constant after the fault occurs.

3) Constant power method
   Considering rotation speed variation, the governing equation is:
   \[ P_m - P_e = J \frac{d\omega}{dt} \]
   where \( T_m \) stays constant after the fault occurs.

Field current

1) The short circuit fault models in three methods result in similar peak values in transient processes, then different mechanical conditions take effect and lead to different final states. Based on this finding, the optimal method can be chosen to model an HTS wind generator under short circuit fault conditions depend on simulation time, that is, any one method for transient peak values, but the constant power method for the whole process.

2) Decreasing the moment of inertia to decelerate the rotor more rapidly during the fault is effective on protecting the HTS winding by shortening the pulse width of field current.