Influence of the Modeling Depth and Voltage Level on Circulating Currents in Parallel Conductors of a Permanent Magnet Synchronous Machine

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Objectives

- Find a FEA setup with minimum computational demand to calculate AC losses of a PMSM including circulating currents
- Investigate the influence of unknown strand positions on the AC losses
- Analyze the influence of the voltage level on the AC losses

Winding Modeling Depth

- Single strands modeled in...
  - Pole model
    - three phases
    - one phase
    - half phase
  - Slot model
    - one phase
    - two phases

Machine Characteristics

- Nominal Power 160 kW
- Maximum Power 250 kW
- Nominal Speed 3000 rpm
- Maximum Speed 9000 rpm
- Voltage Level 800 V
- Coil Turns 8
- Strands in Hand 12
- Strand diameter 0.75 mm

Voltage Level

- Increased copper cross section at 400 V
- Increased sensitivity to AC effects

Conclusion

- Pole model with single strands in two coils of one phase is sufficient to calculate the losses
- Significant influence of strand position on the copper loss
- Tendency to higher AC losses at lower voltage levels