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Size Reduction Techniques for Large Scale Permanent Magnet Generators in Wind Turbines[1] HELENA KHAZDOZIAN, RAVI HADIMANI, DAVID JILES, Department of Electrical and Computer Engineering, Iowa State University — Increased wind penetration is necessary to reduce U.S. dependence on fossil fuels, combat climate change and increase national energy security. The U.S Department of Energy has recommended large scale and offshore wind turbines to achieve 20% wind electricity generation by 2030. Currently, geared doubly-fed induction generators (DFIGs) are typically employed in the drivetrain for conversion of mechanical to electrical energy. Yet, gearboxes account for the greatest downtime of wind turbines, decreasing reliability and contributing to loss of profit. Direct drive permanent magnet generators (PMGs) offer a reliable alternative to DFIGs by eliminating the gearbox. However, PMGs scale up in size and weight much more rapidly than DFIGs as rated power is increased, presenting significant challenges for large scale wind turbine application. Thus, size reduction techniques are needed for viability of PMGs in large scale wind turbines. Two size reduction techniques are presented. It is demonstrated that 25% size reduction of a 10MW PMG is possible with a high remanence theoretical permanent magnet. Additionally, the use of a Halbach cylinder in an outer rotor PMG is investigated to focus magnetic flux over the rotor surface in order to increase torque.

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