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Superconducting Magnet Design for a Vertical-ring High Gradient Magnetic Separation System

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This paper describes a design of a Vertical-ring High Gradient Superconducting Magnetic Separation (VHGMS) magnet for recovery of the magnetic ore and purification of non-metallic minerals. Compared to the conventional design which uses copper wires, using superconducting magnet can help reduce the energy consumption and increase the magnetic field. The first part of this paper introduces the operation margin design of the superconducting magnet. This magnet is wound with NbTi wires and its temperature margin is designed to be higher than 1K. It generates an average magnetic field above 2T in the filtering area. The second part of this paper introduces a quench protection circuit implemented in this magnet and post-quench analysis is also presented. Simulation results show that maximum temperature and terminal voltage are within the safe limits of 270K and 1000V, respectively. So the superconducting magnet can be effectively protected from burning-out during a quench. The third part of this paper analyzes the stresses during magnet charging and quench process. The hoop stress of the coil is limited to be less than conductor's yield stress.

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