Improvements on the Cooling Efficiency of a Double-evaporator Thermosiphon for 100 kWh SFES

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A double-evaporator thermosiphon for the 100 kWh superconductor flywheel energy storage system (SFES) has been designed and manufactured. The double-evaporator thermosiphon consists of an upper and lower evaporator, each designed to indirectly cool the upper and lower superconductor bearing of the 100 kWh SFES by heat conduction. This allows for a smaller gap between the superconductor and the permanent magnet of the bearing, increasing the performance of the bearing. Also, the thermosiphon relies on passive heat exchange based on natural convection, therefore freeing the cooling system of a cryostat, heat exchanger, and LN_2 transfer lines, which are required in commonly-used cooling systems. This type of simple and compact cooling system offers more flexibility in the design of the 100 kWh SFES.

Various experiments were performed to improve cooling efficiency and customize the double-evaporator thermosiphon for the 100 kWh SFES. The internal pressure of the double-evaporator thermosiphon was varied during the cooling process and steady-state operation to control the cooling time and temperature difference between the two evaporators. Also, radiation shielding methods were varied to maximize insulation while avoiding any interference with other members of the SFES. Finally, insulation supports were designed to minimize heat conduction while securing the required rigidity of the thermosiphon.

keywords : double-evaporator, thermosiphon, 100 kWh SFES