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Thermal characteristics of a prototype HTS quadrupole magnet for In-flight fragment separator of RISP

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A prototype HTS (High Temperature Superconductor) quadrupole magnet of In-flight fragment separator was developed and successfully tested to generate field gradient of 9 T/m. This paper describes thermal characteristics of the quadrupole magnet. The magnet is composed of four race-track coils and each coil consists of two double pancake coils with ReBCO wires and stainless steel tape for turn-to-turn metallic insulation. The magnet is cooled by circulation of gaseous helium below 40 K instead of the conventional liquid helium cooling because the magnet will be used at an intensive neutron radiation region. The gaseous helium is generated by a separate cooling system composed of a cryogenic blower and three GM cryocoolers. To cool down and remove the heat penetration, helium channels are installed on the surface of coil bobbins and they are connected to the external cooling system. The test was conducted to find out the optimum operational parameters of the cooling system since the coil temperatures depend on the inlet temperature, the pressure and the mass flow rate of gaseous helium. By adjusting the helium pressure (5~8 bar) and the mass flow rate (5~10 g/s), it was possible to keep the magnet temperature below 40 K while the magnet generated the field gradient of 9 T/m by transporting the rated current of 330 A.
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