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## **C2Po2C-05 [05]: A Cryogenic System for 23 kV-2 kA SFCL with GM Coolers and Inverter Compressors**

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A cryogenic cooling system is designed for three-phase 23 kV-2 kA superconducting fault current limiters (SFCL) under development as an Open R&D Program of KEPCO. The goal of this design is a compact, efficient, and cost-effective cryogenic system as commercial product, based upon our successful long-term operation of distribution level SFCL's. Three phases of HTS components are immersed in a liquid-nitrogen cryostat and continuously refrigerated by four units of GM coolers. A major issue is how to achieve the intended temperature and pressure around at 78 K and 0.3 MPa under "variable" thermal load, because the actual current level will be well below 2 kA during most of operating hours, and the coolers should be able to cover the full load at 2 kA. The state-of-the-art inverter compressors are employed for the partial load operation of GM coolers by controlling the input power frequency. The cryogenic thermal load is elaborately calculated as a function of operating current, and the inverter frequency is controlled directly by the measured actual current such that the refrigeration can match the partial load. Three pairs of current leads are also designed by taking into account their connections to electrical bushings at the top plate, and full details of drawings are presented for immediate manufacturing.

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