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C2Po2C-03 [07]: Hydraulic characteristics of liquid nitrogen at the slope section in a concentric HTS cable

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High temperature superconducting (HTS) cable, hallmarked with high energy density and compact corridor occupation, advanced rapidly in the past decades. In practical operation, it is common that the cable is under a not so straight pathway and slope will make the local cryogen behave against our expectation and hazard the cooling condition. In the paper, we build a detailed slope section model of a concentric HTS cable and give a multi-physics coupling formulation of the model's fluid, thermal, and structure fields. Numerical solutions of the model are obtained by employing computing fluid dynamics and finite element method. We analyze the flow characteristics, heat transfer performance, and temperature distribution variation of local liquid nitrogen along the slope section and related factors such as slope scale, cryogen velocity, and inlet pressure are all considered. Based on the results obtained in the meticulous model above, we propose a convenient experience-based method to determine the local design parameters in engineering practice.

Author: Mr WANG, Bangzhu (Beijing Jiaotong University)

Co-authors: DAI, Shaotao (Beijing Jiaotong University); Dr MA, Tao (Beijing Jiaotong University); Mr HU, Lei (Beijing Jiaotong University); Dr ZHANG, Teng (Beijing Jiaotong University)

Presenter: Mr WANG, Bangzhu (Beijing Jiaotong University)

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