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M3Or3A-03 [Invited]: Development of CORC® power transmission and fault current limiting cable systems

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Next generation electric power systems require higher capacity, efficiency, and stability to meet the demands of increasingly complicated grid systems. High-temperature superconducting (HTS) Conductor on Round Core (CORC®) power transmission cables provide unique solutions by offering high operating currents and current densities in a very small cable cross-section, which can also include the ability to protect electric power apparatus by serving as a fault current limiting (FCL) cable.

Advanced Conductor Technologies is developing 2-pole dc transmission cables, cable terminations, and connectors to be cooled with pressurized cryogenic helium gas for shipboard use. The development and successful test results of a 10-meter long, 2-pole dc CORC® power transmission cable, rated at 4,000 A per phase, will be discussed. The development includes CORC® feeder cables that form the connection between the room-temperature bus bar and the CORC® power transmission cable located inside the helium gas environment.

In addition, the inherent FCL capabilities of a short kA-class CORC® wire of less than 4 mm thickness are demonstrated in liquid nitrogen, developing nearly instantaneous voltages in excess of 20 V/m that increased to about 70 V/m within 15 ms of applied overcurrents up to 250 % of the critical current. Enhanced current sharing between tapes enabled by the CORC® cable topology appears to mitigate the issue of hot-spots caused by inhomogeneities on the HTS tape level by providing several alternate superconducting routes for current to bypass low I_c sections of the tapes. Operation of the CORC® FCL conductor in stand-alone operation and operated as part of a hybrid-cable system, in which the overcurrent is redirected to a normal conducting path outside of the cryogenic environment, are demonstrated without any degradation of the CORC® wire performance.

Authors: WEISS, Jeremy (Advanced Conductor Technologies); VAN DER LAAN, Danko (Advanced Conductor Technologies); Dr KIM, Chul (Florida State University); PAMIDI, Sastry (The Florida State University)

Presenter: WEISS, Jeremy (Advanced Conductor Technologies)

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