

Development of a 1 MVA 3-Phase Superconducting Transformer using YBCO Roebel Cable

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Abstract - We present design details for the planned construction of a 3-phase 1 MVA 11 kV/415 V transformer using YBCO Roebel cable (YBCO - Yttrium Barium Copper Oxide second generation high temperature superconducting coated conductor). The YBCO Roebel cable is a promising technology for carrying high currents. It simplifies manufacture of the winding while managing AC loss. We present the transformer winding design which follows a simple layout with the low-voltage windings utilizing a 15-strand x 5 mm (15/5) Roebel cable in a single-layer 20 turn solenoid. The target rated current capacity of the cable is 1500 A rms at 77 K. The high-voltage winding will be in the form of a stack of double pancake coils arranged on a composite former outside the low-voltage windings. The coils will be immersed in sub-cooled liquid nitrogen with a target maximum operating temperature of 70 K. The development methodology is described along with the results of experiments and modeling to validate the performance characteristics of the windings. Experiments on heat transfer from the windings are presented.

Index Terms - Cables, Cryogenics, Superconducting Transformers.

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