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Evaluation of Selection Criteria for the Level of Liquid Nitrogen in HTS Magnet System

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The High Temperature Superconducting (HTS) magnet system is immersed in a sub-cooled liquid nitrogen (LN₂) and continuously refrigerated by a cryogenic cooling system. Especially, in case of the side-wall cooling type, the HTS magnet system is located well below the level of LN₂ for thermal and electrical safety and the cryogenic gaseous nitrogen (CGN₂) is filled above LN₂. However, the method of determining selection criteria for the optimum level of LN₂ in HTS Magnet System has not been yet deeply investigated. . Therefore, in this work, the process of determining the selection criteria for the level of LN₂ in HTS Magnet System is proposed. A sphere-to-plane electrode system made with stainless steel is used under DC and DC superimposed overvoltage. A sphere electrode is surrounded by CGN₂ and a plane electrode is immersed into LN₂ and, the dielectric experiments are performed according to the level of LN₂. The electric field intensity according to the level of LN₂ is calculated by the finite element method (FEM) and is analysed using the weibull distribution. Moreover, the electric field utilization factor is adopted to analyze the uniformity of the electric field of the electrode system. As a result, it is found that the selection criteria for the level of LN₂ influenced the cryogenic design of the HTS magnet system.

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