1. Abstract

The three-phase superconducting current limiter is a future-generation power system designed to improve the power system safety. Along with the development of diverse types of superconducting current limiters, diverse measures are proposed to improve the limiter's performance. Especially, various studies are being conducted to reduce the volume and weight of superconducting current limiters using iron core and coil. This study manufactured the superconducting current limiting device using the coated conductor with a high resistivity, and applied it to two models involving the iron core and coil (the model consisting of three iron cores and coils each separated and the model integrating 3 coils through one iron core) so as to compare and analyze the current limiting characteristics.

2. Properties of YBCO thin-film wire

- Properties of fault current limiting element.
  - YBCO coated conductor (AMSC 3445)
    - Stabilizer: Stainless steel
    - Length of pattern/width/Nichrome/2mm
    - Layer of stabilizer/overlay/substrate
    - Voltage ratings: 0.6kV/2800000Ω
    - Resistance: 1.38Ω/720K
    - Resistance variations according to temperature of the non-laminated coated conductor.

3. Experimental Set up

- Test system diagram of the experimental circuit

4. Structure and principle of operation of the model with the iron core and coil separated into three phase and the integrated model

- The structural diagram of the separated model and the structural diagram of the integrated model.

5. Analysis of current limiting characteristics of the integrated model of iron core and coil and of the model with separation thereof

- The test results of the current limiting characteristics of the separated model and the integrated model in the case of additive polarity wiring.
- The test results of the quench voltage generated of the separated model and the integrated model in the case of additive polarity wiring.
- The test results of the quench voltage generated of the separated model and the integrated model in the case of additive polarity wiring.
- The test results of the quench resistance occurrence trend of the separated model and the integrated model in the case of additive polarity wiring.
- Like in the additive polarity wiring, the generated voltage of the device offers a greater level with the separate model, because the superconducting current limiting element of the separate model. Meanwhile, Left Figure (b) confirms that, in the sound phase S phase, voltage is generated in the superconducting current limiting element of the integrated model, and this can be confirmed at the generated resistance of the superconducting current limiting element.

6. Conclusion

The three-phase superconducting current limiter, made up of the iron core and coil, is one of the diverse types of superconducting current limiters. In order to compare and analyze the current limiting characteristics of the two models, this study manufactured and tested the model wherein the three-phase superconducting current limiter consists of three coils and three superconducting current limiting elements via a single iron core, and the model wherein iron core and coil, and the superconducting current limiting elements are divided into three units each. Based on the current limiting rate, the current limiting performance of the two models was compared, revealing that, in both subtractive polarity and additive polarity wiring modes, the separated model offers superior current limiting performance compared to the integrated model. However, in terms of the current limiting rate, the two models have no big difference. Further, the reason that the two models showed a different current limiting rate under subtractive polarity and additive polarity wiring is that the magnetic flux was generated more in the case of additive polarity wiring than the subtractive polarity wiring. Meanwhile, the integrated model generated quench resistance even in the sound phase, because it was attributable to the structure of integrated model. Considering the above test results, the integrated model has the advantage of reducing the thermal strain caused to the separate model, but has the problem of generating quench resistance even in the sound phase. If the quench resistance of the sound phase generated can be reduced through the analysis of the integrated model structure (measures to increase the critical current of the superconducting current limiting element along with the analysis of structure), it will offer the measures designed to reduce the volume and weight of the superconducting current limiter using the iron core and coil.