Comparative Study on Current Limiting Characteristics of Transformer Type SFCL with Common Connection Point between Two Secondary Windings

Tae-Hee Han[1], Shin-Won Lee[2], Sung-Hun Lim[3]

JUNGWON UNIVERSITY

1. Department of Aero Materials Engineering, Jungwon University, Chungbuk 367-805, Korea, 2. Department of Computer System Engineering, Jungwon University, Chungbuk 367-805, Korea, 3. Department of Electrical Engineering, Soongsil University, Seoul 156-743, Korea

Abstract

In this paper, the transformer type superconducting fault current limiters (SFCLs) with common connection point between two secondary windings, which was similar structure to the previously suggested transformer type SFCL with two triggering levels, were proposed and their current limiting characteristics were compared. The suggested transformer type SFCLs consist of the primary winding and two secondary windings with common connection point. However, the current limiting operations through two triggering levels, which can be generally adjusted by the winding direction and the number of turns between two secondary windings, are affected by the application position of two high-T_C superconducting (HTSC) elements into the transformer type SFCL with common connection point. To analyze the dependence of the current limiting operation on the application position of two HTSC elements, the short-circuit tests for the transformer type SFCL with two different positions of two HTSC elements were carried out and their current limiting characteristics were compared from the point of view of the power burden and the accumulated energy of two HTSC elements comprising each transformer type SFCL.

Conclusion

The present paper proposes transformer type SFCLs that have a common connection between two secondary windings. It also analyzes through short-circuit simulation experiments the excess current limiting characteristics at fault occurrences depending on the configurations of the transformer type SFCLs that have two operation currents based on the superconducting element positions. The following conclusions were obtained from the present study. The results of the simulation experiments showed that the quench time gap and the peak current, voltage, and resistance differences between the two superconducting elements were smaller in Type A than in Type B. However, Type A has an advantage over Type B with regard to the instantaneous power and energy consumption difference between the two superconducting elements.

Methods

Structure and Principle

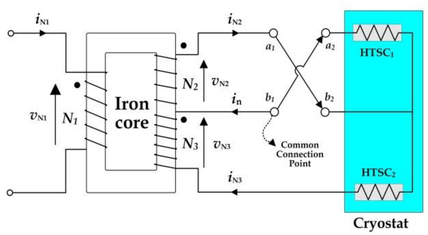

Fig. 1. Schematic configuration of the transformer type SFCL with a common connection between two secondary windings

Equivalent Circuit

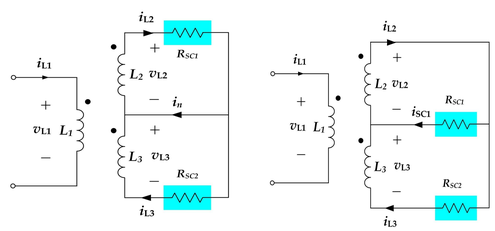

Fig. 2. Equivalent circuit of the transformer type SFCL with a common connection between two secondary windings. (a) In case of A (a_1-a_2, b_1-b_2) type, (b) In case of B (a_1-b_2, b_1-a_2) type.

Configurations of Experimental Apparatus

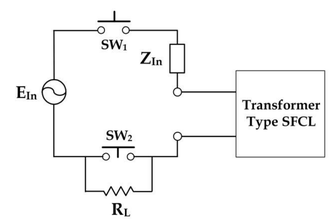

Fig. 3. Experimental circuit for the short-circuit test of a transformer type SFCL with a common connection between two secondary windings

Results

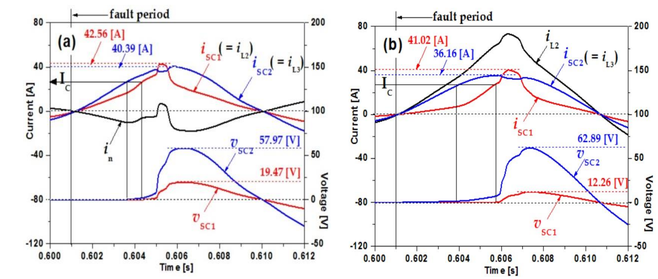

Fig. 4. Transient fault current limiting characteristics of the transformer type SFCL with a common connection between two secondary windings. (a) In case of A (a_1-a_2, b_1-b_2) type, (b) In case of B (a_1-b_2, b_1-a_2) type

Results

Transient Fault Current Limiting Characteristics

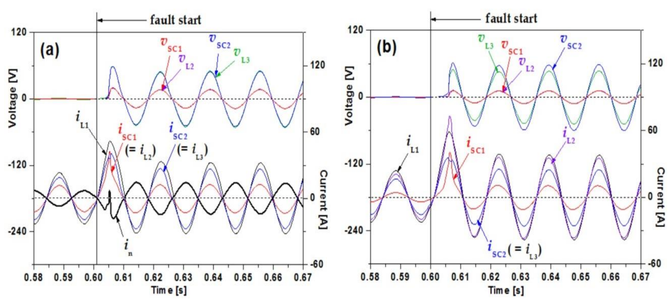

Fig. 5. Transient fault current limiting characteristics of the transformer type SFCL with a common connection between two secondary windings. (a) In case of A (a_1-a_2, b_1-b_2) type, (b) In case of B (a_1-b_2, b_1-a_2) type

Voltage and Current Characteristics

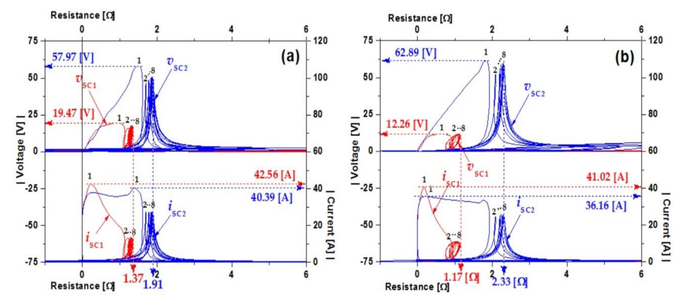

Fig. 6. The voltage and current characteristics depending on the resistance during a fault in a transformer type SFCL that includes a neutral line in the secondary windings. (a) In case of A (a_1-a_2, b_1-b_2) type, (b) In case of B (a_1-b_2, b_1-a_2) type

Instantaneous Power and Energy Consumption

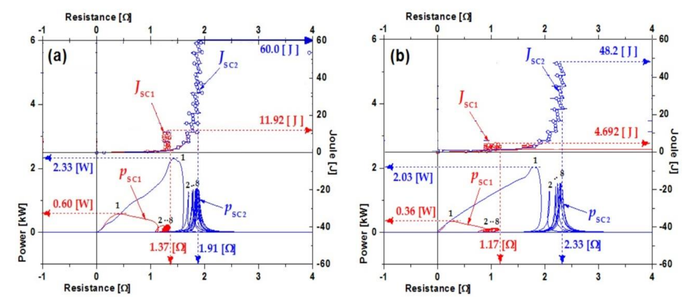

Fig. 7. Resistances and Power burdens of two HTSC elements comprising the transformer type SFCL with additional circuit. (a) In case of the additive polarity winding. (b) In case of the subtractive polarity winding.

The 25th International Conference on Magnet Technology, 2017 Aug. 27 – Sep.1, Amsterdam, the Netherlands; Session: Tue-Af-Po2; Program I.D. number: #1001