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Study of HTS 2G superconductor tape properties for applications in SFCL

Abstract. *The article will present the results of experimental investigations of the High Temperature Superconducting tapes (2G HTS) used for the construction of Superconducting Fault Current Limiter (SFCL). The test results shown are of great importance due to the possibility of learning about the phenomena occurring in the tape during the SFCL action and considering them in the process of constructing the limiters.*

Keywords: Superconducting tapes, Superconducting Fault Current Limiter.

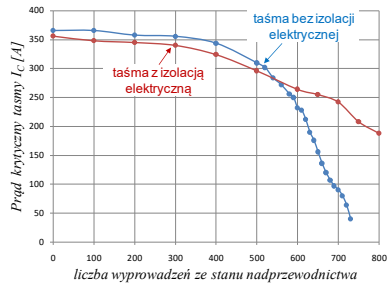
Introduction

Due to the development of electric power industry based on renewable energy sources, the centralized character of the power system is transformed into a distributed system, in which electricity is generated in generating units connected to medium and high voltage networks. This increases the value of the expected short-circuit currents that pose a threat to the network infrastructure at the point of connection. An alternative to the need to modernize the network can be the use of superconducting fault current limiters (SFCL). In the SFCL construction, high temperature superconductors (HTS) are most commonly used in the form of tapes with a layered structure. However, the analysis of the SFCL operating conditions in the power network requires, in addition to the I_C current values, consideration of the thermal and electrical characteristics of the tapes in the resistive state, in order to preserve the functional parameters and reliability of the power system protection [1].

Experimental results

Figure 1 presents the investigation results of the tapes properties, important from the point of view of SFCL operating conditions in the power grid. Repeated transitions to resistive state of the tape from the superconducting state by means of surge current pulses can lead to the degradation of the tape and the reduction of the I_C current (Fig.1a). It has been found that a layer of electrical insulation delaying the degradation process. A similar degradation process was noticed as a result of the thermal transition to resistive state of tapes [6]. Fig.1b presents the dependence of the tape return time to a superconductivity state as a function of the value of the load current forced in the resistive state. This parameter is decisive for the possibility of SFCL operation in system with automatic reclosing, and the research results can be used in the process of modelling of thermal and electrical properties of tapes [1, 3, 4].

a)



b)

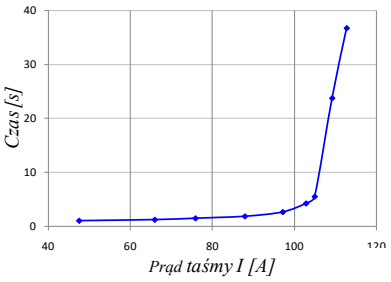


Fig.1. Test results of HTS strip properties: a) dependence of the HTS strip's critical current value as a function of the number of leads out of the superconducting state of the surge current, b) characteristics of HTS tape return time to superconductivity as a function of the forced current value.

Summary

The presented results of the high-temperature superconductor tape used in the SFCL construction have shown that the processes occurring during the activation of the limiter can lead to degradation of the tape and deterioration of its parameters and, in particular, lowering of the critical current. This may result in incorrect SFCL operation of the system. Thermal phenomena occurring in the tape in a resistive state are of fundamental importance for SFCL cooperation with power system protection. These properties must be taken into account when designing SFCL.

References

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