Analysis and experiment on failure of conducting rod of converter transformer bushing

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Abstract. Transformer bushing is an important part of transmission engineering, its structure safety is very important. In this paper, the failure of the conductor rod of the high voltage bushing of a 750kV transformer is analyzed. The high voltage bushing of this transformer is made of oil paper capacitive structure. The conductor rod used to transport the current inside the high voltage bushing bears the current and the tension from the pressing spring. Based on the finite element simulation and experimental research, this paper analyzes the fault cause is the insufficient strength of the conductive rod connector, and gives the operation and maintenance suggestions.

1 Introduction

As the most important component of UHV DC transmission project, transformer capacity and voltage level continue to improve, making the operation and maintenance of UHV transformer to a new level of technical difficulty. The bushing leads the high and low leads inside the transformer to the outside of the oil tank. It is a channel for the current carrying element of the main transformer to interact with the internal and external energy. In addition, it also plays a role in insulating the ground, supporting the lead and isolating the outside. Therefore, the sealing performance, electrical strength, mechanical structure, thermal stability is very important to the main transformer HV bushing. The fracture is shown in Fig 1.

An instrument for monitoring the condition of transformer bushing is proposed in [1]. Two methods of casing monitoring are also introduced. Reference [2] analyzes the partial discharge characteristics of transformer casing failure, considers the implementation of partial discharge diagnosis technology to identify casing faults at an early stage as a means to prevent casing failures, and examines the feasibility of implementing these technologies. Reference [3] analyzes a transformer casing damage accident by looking for the casing penetration crack under the main casing, the effectiveness of oil chromatography combined with electrical testing is verified. Through theoretical analysis, simulation research and experimental verification, this paper studies the fracture behavior of transformer bushing conductive rod connector. The FEM model of transformer bushing conductive rod connector is established and its tensile stress, stress concentration and tensile fracture behavior are evaluated. The research flow and experimental equipment of fracture behavior of transformer bushing conductive rod connector are shown in Table 1.

2 Simulation and experiment on fracture of conductive rod connector

Conductive rod fracture connection material is pure copper, conductive rod bottom is fixed, gradually increase the displacement distance of the other end. The transformer bushing structure is shown in Fig 1. The above conditions are substituted into the finite element model of the rod connector considering the boundary conditions. Judge the tensile strength of the connector according to the required displacement distance and stress. Table. 1 shows the stress and

displacement of conductive rod under different tensile forces. In the simulation results, before the displacement and deformation of 2.1mm, the stress in the middle of the connector increases with the intensification of the displacement and deformation between the connections. When the displacement is 2.4-3mm, cracks appear and expand between the connectors. When the displacement reaches 3.3mm, the connector breaks completely.

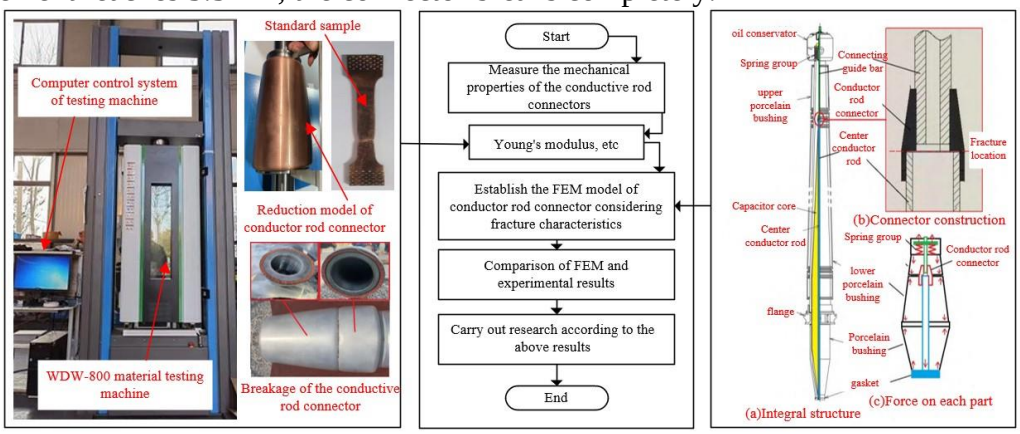

Fig. 1 Reserch process flowchart

Table 1 The simulation results

Item	Simulation	
Tensile fracture of conductor rod connector	d=0.3mm	d=2.4mm
	d=2.7mm	d=3.3mm

3 Conclusion

In this paper, the fracture behavior of conductive rod connector of high voltage bushing of converter transformer is studied by theoretical analysis and finite element analysis. The FEM model of conductive rod connector is established. At the same time, the standard tensile sample and shrinkage model were tested, and the theoretical analysis and finite element simulation were verified. Provide guidance for safe operation of transformer bushing conductor rod. Detailed experimental results and comparisons will be shown in the full paper.

References

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