EFFECTIVENESS OF VARIABLE FREQUENCY RESONANT METHOD FOR AFTER-LAYING TEST ON HIGH VOLTAGE EXTRUDED CABLE

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ABSTRACT

In order to study the efficiency and the validity of the frequency-tuned series resonant test system for detecting different types of defects, the withstanding test of XLPE cables with typical single defect has been carried out within the frequency range of 20-300Hz, and the relation between the breakdown voltage and frequency has been obtained. The breakdown voltage of the cable with needle in the insulation fluctuated with the frequency, while the breakdown voltage of cable models with other defects almost remained stable.

KEYWORDS

XLPE; frequency-tuned resonant test; defects; breakdown.

INTRODUCTION

High voltage （HV） and very high voltage (EHV) extruded cable become more and more popular and important worldwidely, especially in China[1]. With the development of material and production method, the quality of HV (EHV) cables and their accessories have been effectively controlled. But cable in factory is even not a complete insulation system, which can be put into service only after assembled with accessory. In order to effectively detect typical faults originated during assembly of accessories, after-laying test should be carried out on new installed cable circuits.

It was clear that d.c. testing method is not able to find faults within HV (EVH) extruded dielectric cables, on the other hand, d.c. method may generate new problems in cable system. Very-low frequency (VLF) testing of XLPE cables is only suitable for low-voltage and medium-voltage cables to detect water trees. The effectiveness of oscillating wave (OSW) testing in detecting kinds of defects is better than high-voltage dc testing, but worse than test under power frequency. Power frequency testing which uses the alternating current at the operating frequency of the cable system as the test source seems to be the best method for estimating the conditions of the cables, but it is too heavy to be available for on-site testing. The frequency-tuned resonant test system with the frequency range from 20 to 300Hz has advantages of high efficiency, great reliability, low cost, flexible structure, high quality of output et cetera, and is the best on-site test method for high-voltage cable system, and is the best method which not only fulfils international standard but also is available so far[2,3].

This article focus on the detailed frequency dependence of breakdown character of insulation used in cables systems with different kinds of artificial typical defects within 20-300Hz. Considering the usual dispersion of breakdown voltage of the insulation the two-parameter Weibull function has been chosen to process the breakdown voltages which derived from the frequency-tuned resonant testing in 20-300Hz. The breakdown voltages of different insulation with different defects as functions of frequency are applied and the breakdown mechanism is discussed.

BREAKDOWN TEST AND DATA PROCESSING

Test Sample

The installed XLPE cables may contain a lot of defects in the XLPE insulation and cable accessory. Though these defects have complicated structures, they can be taken as the combination of different kinds of typical single defects. If the insulation performance of XLPE cable models with different basic defects have been studied fully, the fault analysis and diagnosis of the cables will be much easier.

The styles and the preparations of test models with typical single defects were summarized as follows:

Needle defect

Along the radial direction of the 10kV XLPE power cable, insert a needle whose diameter is 1mm and tip radius is 10±1μm. The reserved insulation thickness is 1mm. The needle is grounded during the test. The Figure 1 gives the sketch of this kind of typical defect.

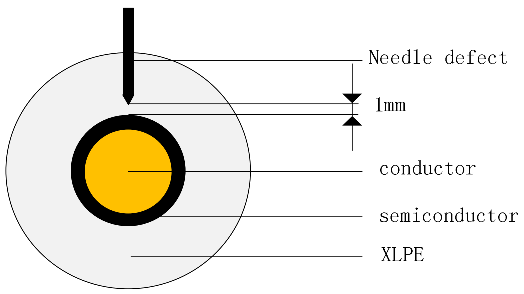

Fig.1: Schematic diagram of XLPE cable model with needle defect