FREQUENCY CHARACTERISTICS OF PARTIAL DISCHARGES IN MV EXTRUDED CABLES USING NON-CONVENTIONAL SENSORS

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ABSTRACT

This paper deals with the frequency response of PD detection by non-conventional PD sensor installed at different position along the MV polymer cable by using PD sources in three different type. The transfer function of the cable combined with the sensor was found to give an effect on the frequency characteristics of PD signals depending on the cable lengths. In addition, it is likely that the conventional PD calibration according to IEC 60270 should be reviewed since the magnitude of PD depends on the frequency response of the nature of PD source.

KEYWORDS

MV extruded cable, Partial discharge detection, Non-conventional PD sensor, Frequency characteristics, PD calibration.

INTRODUCTION

Since PD signals and noises have different frequency band, it could be considered that they might show different propagation characteristics in the cable systems. [1-3] Therefore, difficult inconveniences have been experienced to identify PDs and related location of PD sources due to the attenuation and distortion of the PD signals inside the cable system. [4-6] In this regard, an advanced investigation has been considered necessary in terms of the analysis of frequency for PD signals.

Regarding PD calibration, IEC 60270 has been applied since last three decades where the measuring frequency range is not so wide: from several tens of kHz to several hundreds of kHz. Such narrow band is quite far from the working frequency of non-conventional PD sensors, over the 10MHz, which have been widely employed for the on-site measurement nowadays. In this respect, the applicability of the IEC 60270 calibration became an issue to be investigated when the non-conventional methods are concerned.

In this paper, experimental investigation on the frequency response of the PD detection has been performed using non-conventional two PD sensors installed at different position along the MV polymer cable. And also PD sources in three different types have been used. In addition, with respect to the PD calibration, the conventional method according to IEC 60270 has been examined for its applicability to the non-conventional PD sensors using different types of the PD sources.

EXPERIMENTS

Cable test system was set up as shown in Fig.1 using 22.9kV CNCV cable with 200m in length and the normal joint was installed at 100m from the high voltage terminal. Two sensors are installed at the termination and the normal joint respectively.

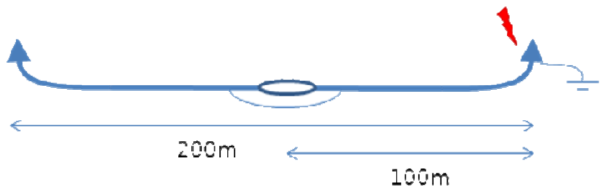
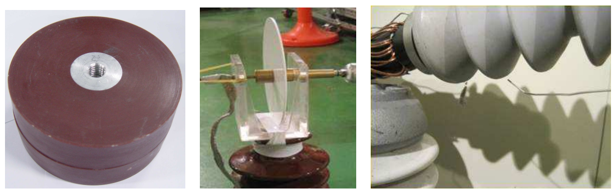


Fig. 1: Schematic diagram of the cable test system

Three artificial PD sources are designed and fabricated as follows: void discharge, surface discharge and corona discharge. In order to simulate the discharge inside the cable insulation due to the void, a cavity is artificially introduced into the epoxy between two electrodes. For the discharge at the interface, a solid insulation disk is fixed between two cylindrical electrodes. Finally, a sharp steel wire located at skirt of the terminal to immitate the corona discharge.



(a) Void (b) Surface (c) Corona

Fig. 2: Three kinds of PD source

Two PD detection methods are under investigation. For the conventional method, PD is detected according to IEC 60270 by use of HAEFELY TE571. For the non-conventional one, our designed sensor with working frequency in HF-VHF has been employed combined with Spectrum analyzer for the signal analysis.

RESULT AND DISCUSSION

In order to investigate the transfer characteristics of the cable test system, Network analyzer was used. Its signal is injected between the conductor and cable sheath at the terminal and then S_{12} (Transfer characteristics) is measured from the sensor output located at two different positions separated 100m from each other.

Transfer characteristics

Sensor

The result for the sensor itself, in Fig.3, shows response ranging widely from 10MHz to 300MHz.