Development of advanced partial discharge measurement for XLPE cable system

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Background and aim of this paper

XLPE cable system is widely introduced in power transmission and distribution system especially in urban area, as well as link lines between power apparatus in substations. It has terminations in its both ends, and joints for long underground transmission lines. Recently, the pre-molded type cable termination and joint are developed and being introduced in the actual power grid, however, pre-fabricated type cable termination and joint were introduced mainly for around 30 years in Japan and many of them have been still under operation.

Such highly-aged prefabricated termination and joint, it is reported that some kind of chemical deposits are formed at the interfaces between different solid materials such as the interface between the stress relief cone and XLPE. The deposits might be a cause of a void at the interface, which might bring about the partial discharge and might lead to the dielectric breakdown. Here, partial discharge (PD) measurement with electrical method is one of the major candidates to prevent that, thus the authors are developing PD measuring technique for XLPE cable.

This paper aims to develop the PD measuring technique for XLPE cable applying the foil electrode method and the high frequency techniques. In the paper, the authors introduce the details of the technology and some measuring examples.

Two foil electrodes are set on the sheath of test cable with a space of tens millimeter, then they are connected to the high frequency amplifier having wide frequency band up to more than 1 GHz. Using such an amplifier, PD pulse signal with its rise time of several nano-second to several hundred nano-second can be obtained with high time resolution of sub nano-second order.

Foil electrodes and an amplifier

The foil electrode consists of a copper or aluminum tape with its width of around 20 mm, which is wound on the cable sheath and rounded tightly. Then it is tightened by a copper wire and is made its end as a signal pickup. Another foil electrode is made with around 10 mm apart from the first one.

The amplifier has two signal inlets, so the inlets are connected to the signal pickups of the two foil electrodes. The amplifier has its frequency range up to more than 1 GHz to obtain the PD signal with high time resolution with sub nano-second. This feature can bring us the single PD waveform. The mechanism of the detection will be discussed on the paper.

Application of the proposed technique

The proposed technique can be applied to PD measurement for the XLPE cable system to detect PD source, as well as flow direction of PD signal. The time difference of arrival for plural measuring point can be realized using plural sets of the foil electrodes and the amplifier, with its time resolution of sub nano-second, ff course an oscilloscope with high time resolution more than 1 G samples per second is required. The detail will be discussed on the paper.