

Application of PD monitored Voltage Withstand Test Method for High Voltage Power Cable Lines

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ABSTRACT

A partial discharge (PD) defect in the cable or cable accessories might lead to a break down accident during operation. The PD monitored voltage withstand test for HV cable had been accepted as a standard acceptance test and diagnostic test methods for power cables by State Grid of China because of the advantages of finding small PD defects. Several key application aspects of PD monitored AC voltage withstand test method were discussed in the paper.

A distributed PD measurement system together with a PD free AC voltage resonant test system were used for such a test. PD detectors were installed along the cable line at each cable joint and terminations. In order to make the PD level shown on each measuring channel comparable, a consistency of PD level for all PD detector units had to be checked.

PD activities were monitored and all PD data were stored from the beginning of voltage regulation to the whole period of voltage test. No PD activity with recognizable PD pattern under test voltage should be acceptable, which might be the recommended PD criteria of such a test. The absolute value of PD level was not so critical in the recommendations of this paper.

Keywords: HV Power Cable, Acceptance Test, Diagnostic test, PD Monitored AC Voltage Test, PD free Resonant Test System;

INTRODUCTION

State Grid of China (SGC) had published a standard "Test Code for Power Cables" Q/GDW 11316-2014^[1] shown as figure 1. This standard specified that partial discharge monitored AC voltage test must be completed for HV power cable lines with voltage 66kV and above with test voltage and test time specified for different rated voltage cables and test purposes. It provided the technical basis for HV power cable on-site tests of Chinese utilities.



Figure1: Test code for power cables

AC voltage withstand test was proofed to be able to find out serious construction faults of power cables. Partial discharge measurement with AC voltage withstand test was able to find out tiny partial discharge defects, which might be developed to power cable breakdown after operation for several months or years.

Distributed PD measurement was a complementary

method to the AC voltage withstand test. Serious construction faults as well as tiny PD defects could be found out and repaired before the operation of the HV power cable lines.

In 2010, PD monitored AC voltage withstand test was firstly used by SINDIA Instruments Co., Ltd. (SINDIA) in 220kV 18.6km power cable lines and one joint with PD defect was found, which was opened and proofed and the test results were published in Jicable'11^[2].

In 2014, PD monitored AC voltage withstand test was successfully used by SINDIA in 500kV 6.7km power cable lines, and the test results were published in Jicable'15^[3].

THE AC VOLTAGE TEST SYSTEM

AC voltage test system based on frequency tuned resonant circuit, shown as figure 2, acts as power source for voltage test and PD measurements. Modular, PD free and movable were the basic requirements for AC power source of the test.

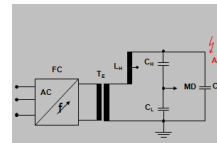


Figure 2: frequency tuned resonant circuit

a) Modular design

Modular designed power sources with the possibility to be connected and controlled in series & parallel were the essential technical requirement for testing of extra high voltage as well as longer power cable lines.

Four modular systems were used for test of 500kV 7.6km power cable lines in 2014 shown as figure 3, with test voltage 493kV and test current 137A.



Figure 3: Four WRV systems used for 500kV 6.7km power cable tests

b) PD free design

PD free power source design under rated voltage was essential requirement of sensitive PD measurement on site. PD generated in the HV power source or HV connections was not able to be separated from PD activities generated inside outdoor termination which connected to the AC power source.

Eight modular systems with PD free were used for the test