INTELLIGENT DTS AND PD MONITORING SYSTEM FOR UNDERGROUND DISTRIBUTION NETWORK

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ABSTRACT

At present, intelligent circuit breaker, switchgear, recloser, transformer and surge arrester were developed. It can communicate with control center of distribution automation system through RTU by DNP3.0 protocol.
Although underground cable is also important distribution equipment it did not considered for on-line monitoring. So, intelligent underground cable monitoring system is under development. It is distributed temperature monitoring system using fiber optic cables. PD monitoring system is also added for the splice monitoring. This system can predict failure and conduct fast restoration owing to fast failure detection and exact fault location.
DTS is common technology for underground transmission cable but it is expensive solution for the underground distribution cable. So this paper proposed economic DTS solution with PD monitoring system.

KEYWORDS

Distributed Temperature Sensing; Partial Discharge; Real time monitoring, Optical fiber composite cable: Intelligent distribution equipment; Fault location;

INTRODUCTION

This paper presents economic DTS solution with PD measurement system for distribution underground cables. Usually DTS system is used for the temperature monitoring and estimation of real time rating of transmission cables[1][2][3][4][5]. But it is not suitable for underground distribution cables because distribution cable network is more complex than transmission one.

Especially underground distribution network have many branch cables at the position of pad mounted switchgears. So DTS system for transmission cables can not be used for distribution cable networks directly and it is very expensive solution for distribution cables.

In addition, with the steady increase in the use of optical communications for power network operation, communication costs of utilities have also seen a sharp increase. Therefore, the use of optical fiber composite cables in power networks is increasing and the expansion of the use of optical fiber composite cables to distribution systems is being reviewed.[6][7] If optical fiber composite cables are used, power line communications will be enabled without having to establish any separate communication networks. However, there is the possibility that communications may be disabled when a failure in the power cables occurs; thus making a failure-preventing monitoring system is indispensable.

Unfortunately underground distribution cables are not monitored in real time due to the lack of economic and accurate monitoring systems. This study was intended to establish an economic and accurate monitoring system for real time monitoring of these underground cables using optical fiber as a sensors for the detection of temperature.

Monitoring systems for optical fiber composite cables used as communication networks should be designed for early detection of failure to prevent failure propagation.[8] In order to use optical fiber composite cables for power transmission and communication in underground distribution network we have to design splicing and branch lines. Especially it should minimize communication failures when power cable fault occurs. Additionally the system can monitor the entire complex underground distribution network with its many feeders and branch lines while being economically viable.

This study presents a cable structure that will enable both power transmission and communications in underground distribution systems and a design for a cable monitoring system utilizing the structure. Especially, the monitoring system can interface with distribution automation systems for effective maintenance and operation.

Continuous PD measurement at every splices in distribution network is expensive. So in this proposed DTS system PD sensors can be connected to this cable at the position of splices and both ends of cable. Distribution network operator can manage the PD measurement site and period.

SYSTEM CONFIGURATION

Optical fiber composite power cable(OFCPC)

The OFCPC was designed as a composite cable with a 22.9kV voltage and a 325mm^2 cross-section. Two stainless steel loose tubes(SSLTs) including 4 optical fibers respectively were positioned between neutral wires.

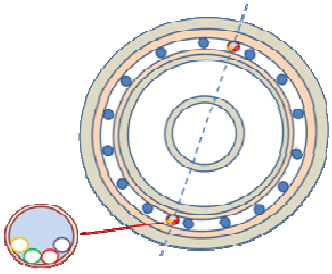

Fig. 1 Structure of OFCPC

The optical fibers of the one SSLT will be used to