Operating Records and Recent Technology of DTS System and Dynamic Rating System (DRS)

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ABSTRACT

Distributed Temperature Sensing (DTS) system is utilized for power cable temperature monitoring regarding its long length distributing measurement capability. Dynamic Rating System (DRS) provides conductor temperatures and cable ratings in real time. JPS has supplied the DTS and the DRS as a cable manufacturer, and they have more than 15 years operation history. This paper reports operating records and recent technology on these DTS and DRS.

KEYWORDS

DTS, Distributed Temperature Sensing System, DRS, Dynamic Cable Rating System

INTRODUCTION

Distributed Temperature Sensing (DTS) system is capable to measure the temperature distribution of an optical fibre, and utilized for power cable temperature monitoring regarding its long length distributing measurement capability.

Dynamic Rating System (DRS) provides conductor temperatures and cable ratings. The calculation is based on IEC standard formula, and done by a combination of the temperature measured by DTS and cable load current. The system is connected to the substation supervisory system, SCADA, to send out alarms, temperature and cable rating figures, as well as to receive load current for the calculation.

They all are done on real-time basis so that they contribute to the cable system operation and maintenance.

JPS has supplied the DTS and the DRS as a cable manufacturer, and they have more than 15 years operation history.

DTS

DTS Technology and Equipment

DTS is a technology to measure the temperature distribution of optical fibre by means of back-scattering phenomenon. Our DTS unit uses the technology of combination of Raman Scattering and OTDR (Optical Time Domain Reflectometer).

Fig. 1 shows the measurement principle of DTS. The light pulse injected at one end of the optical fibre is subjected to scattering due to temperature gradients as it travels along the fibre.

Raman scattering consists of Stokes and Anti-stokes light components of which the wavelength is a bit shifted from the original wavelength. The temperature where the scattering occurred especially affects the intensity of Anti-stokes light. The Raman backward scattering light is divided into Stokes and Anti-stokes and captured by photo detectors. The temperature is calculated by the intensity ratio of Raman scattering and the location is determined by the traveling time of scattering light.

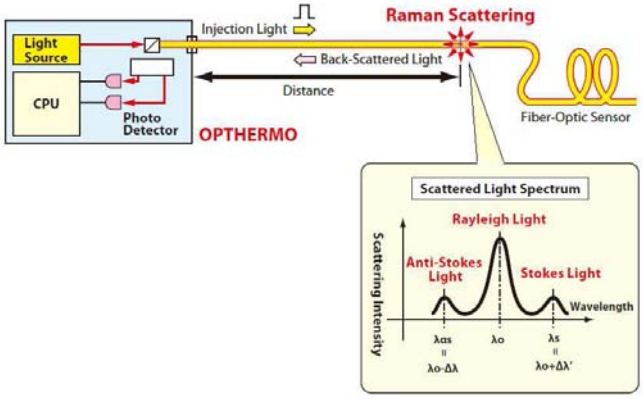

Fig. 1: Measurement Principle of DTS

DTS provided by authors can measure up to 30km with 1m sampling using 50µm/125µm Multi-mode optical fibre.

DTS Fibre Cable

The goal of cable temperature monitoring is to measure the conductor temperature itself. Generally, the closer the optical fibre is to the conductor the more accurate the measurement. However it is not easy to install optical fibres in or on the conductor because of the insulation issue.

There are several approaches of laying DTS fibres depending on the limitation of the installation or the cost-effectiveness: attached to or incorporated in the power cables, installed in the communication conduits.

The optical fibre cores shall be appropriately protected to ensure the continuous monitoring for the lifetime of power cable. DTS fibre cables provided for those purposes are shown in **Table 1**.

Table 1: DTS Fibre Cables

Type	Field
Stainless-tube	Incorporated in power cable
Stainless-tube with HDPE jacket	Directory burial
Non-metallic Cable	Communication Duct, Tunnel

The optical fibre core for DTS measurement is the same as for the optical fibre communication. The cable joint for fibre-incorporated cable has an external fibre-optic splicing tray. The DTS optical fibre cores can also be used for another purpose say the communication path for the on-line Partial Discharge measurement.