THE NECESSITY ANALYSIS OF DISTRIBUTED FIBER-OPTIC TEMPERATURE MONITORING BY XIAMEN POWER CABLE ALARM CASE STUDY

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ABSTRACT

This paper introduces the application results of Distributed Fiber-optic Temperature Monitoring System (DTS) used in Xiamen Power utility for 220 kV power cable operation monitoring. In November 2007, one cross bonding box earthing problem caused by water leakage in a cable joint manhole was detected. In terms of the deployed DTS system this problem was resolved in time, successfully preventing the potentially serious large-scale cable faults. Thus to demonstrate the theory of DTS system for larger applications, this paper presents the reliability, sensitivity and usage of DTS in relation to the temperature monitoring.

KEYWORDS

Distributed Fiber-Optic Temperature Monitoring; Power Cable operation monitoring; Temperature Alarm; Cross Bonding; Short Circuit

INTRODUCTION

Xiamen is an island city of Fujian province, China. The power supply to this city is based on 5 circuits of 220 kV power lines, while 3 of them are mixed with overhead lines and power cable lines. In order to optimize the limited land resources, Xiamen has decided to replace the old overhead transmission lines with underground power cable lines gradually. Until May 2008, 243km power lines with voltage 110 kV-220 kV are in place, whereas 62km lines, approximately 26%, are represented by underground cables. With the granting of a series of Power Cable Lines Projects in FangHu district, the proportion of power cable lines is expected to further enhance, reaching at 35% in years. In these circumstances, the reliability of underground power cable lines has become vitally important for the entire power supply system in Xiamen. In order to better monitor the operating conditions of power cable lines, starting in 2005 Xiamen Power Utility has deployed a set of DTS systems (Distributed Fiber-optic Temperature Monitoring Systems) in 2005, equipping with the power rating system upon DTS as a pioneer in China.

The first DTS system was put into operation in 2005, with 4 channels monitoring two 220 kV lines, one 110 kV line, and one 10 kV line respectively (as shown in Figure 1). The monitoring results, as well as the corresponding temperature curve plotted in real-time, were accessible via the internal networks for the authorized personnel. In addition, the DTS system includes the capability to automatically update the maximum temperatures and locations in each channel via SMS to any designated mobile addresses. Valuation and testing results indicate that these features of DTS have improved the efficiency of power cable maintenance to considerable extents.

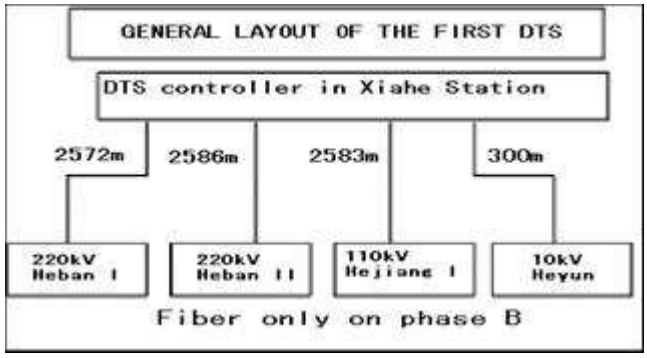

Fig. 1 Power cable temperature monitoring system

The system has been in operation for 6 consecutive years, effectively prevented a high temperature issue on 13 November 2007.

CABLE HIGH TEMPERATURE ALARM CASE AND URGENT SERVICE

On 2 November 2007, Xiamen cable maintenance engineers detected that the maximum temperature in a 220 kV line showed consecutively increasing trend on daily basis, according to the alarming SMS received from the DTS. Xiamen engineers reported this exceptional situation and started to check the history monitoring data log. On 7 November the increase rate of cable temperatures was doubled, which led to the temperature, at 18:00 on 12 November, to reach at 48℃

In terms of the above information engineers from the Power Transmission Department went for on-site check immediately. Initial detection showed that 30# man hole was filled with water, and the surface water temperature was 84℃, far exceeded the normal range. To deal wi th the situation immediate actions were taken to pump the water out from the hole for further cable system investigation. After two on-site investigations at 13 November and 14 November, it was found the faults were mainly attributed to the short circuit when water went into the cross-bounding box accidentally, which gradually heated up the surface water in the man hole. Based on the investigation results contingency plans were made and executed in due course, resulting in the decrease of surface water temperature started to decrease. After 3 hours the DTS reported that the temperature went below than the alarming threshold, reaching at 55? as shown in Figure 2.1 and Figure 2.2. Simultaneously, senior engineers were allocated to resolve the water leakage problem of all joint boxes in man hole 30# as well.