RESEARCH OF UPGRADING AMPACITY FOR HIGH VOLTAGE XLPE POWER CABLE

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ABSTRACT

In order to accurately investigate the ampacity for a typical whole power cable circuit, a full-size experimental setup which simulate various practical operating conditions is conducted, including in vertical shaft, in duct bank, in fireproof box. The ampacity of the power cable under these operation conditions is determined and decrease factor of the ampacity is also given. The hot spots are decided by the test results.

Two methods are used to remove local hot spots, including using force-cooling and using thermal backfill. A water-cooling system is developed, which uses cooling water circulated through pipes placed near the cables.

The results in this paper show that the uprating method can effectively increase the ampacity of the power cable circuit. The results of research can instruct the ampacity control and uprating of the 110 kV power cable circuit in operation.

KEYWORDS

Ampacity, decrease factor, local thermal effect, uprating, force cooling, thermal backfill

INTRODUCTION

The length of the high voltage power cable in state gird is increased as the growth of the economy of the China for recent ten years, the length of the power cable circuit above 110 kV is above 9000 km [1].

It is a hard task to manage these power cable circuits. The amapcity of power cables is a key important parameter for urban grid. Ampacity determination is the heart of underground transmission and distribution cable system design and operation. Amapcity of the power cable circuits is usually determined by design department before the power cable put into use, and the ampacity is calculated according to IEC 60287[2, 3]. While there are many laying methods in China, and many auxiliary facilities are used to protect power cable circuit, the power cable circuit operated in nonstandard operation conditions beyond IEC 60287. In order to avoid overheating, the design department will adopt the most severe condition and give a discount to the calculated ampacity.

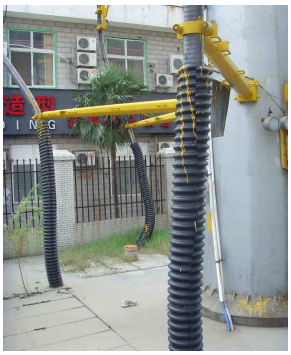
Nowdays, the load of the power cables increases with the growth of the urban, and the load current of many power cables exceed or close to the design value. In order to improve the economy and reliability, the design ampacity value should be re-evaluated or be improved. SGEPRI has carried out the research to evaluate the ampacity of the power cables under non-standard laying methods [4]. The results are used to re-evaluate the design amapcity values of power cables in operation.

The dynamic ampacity techniques based on DTS are widely used, it is a condition monitor techniques and can exploit the potential of the power cable circuit. While this method can not improve the operation thermal conditions of the power cable circuit. In order to improve the amapcity of the power cable circuit, some techniques should be adopted to improve the thermal circumstance. One method is remove hot spots induced by local thermal effect.

Two methods are used to remove local hot spots, including using force-cooling and using thermal backfill. A water-cooling system is developed, which uses cooling water circulated through pipes placed near the cables. The two methods are verified by test results in the power cables laid in a 3X3 duct banks and a cable duct.

AMPACITY UNDER SPECIAL LAYING METHODS

A power cable circuit frequently has different laying methods, Fig. 1 shows two laying methods in a practical power cable circuit, (a) is a short section of cable located in a protective riser, when underground cable system is connected to the overhead line, (b) is the underground cable which is laid in a fire-proof box. The ampacity of the whole power cable circuit is often limited by the laying methods. The duct banks are widely used in practical circuits, and it is also a thermal bottleneck [5]. So, a serial of experimental investigations are performed to analysis the effect degree of these laying method on the amapcity of the power cable circuit.



(a) Cable in vertical protect tube

(b) Single cable in fire-proof box

Fig.1: Two typical power cable laying methods

This section presents the test procedures and results about the research test.

Experimental Setup

Three full-size test systems are built up (Figure 2 to figure 4) in order to determine the amapcity reduction factor under the laying methods beyond IEC 60287. The power cable is single-core, type YJLW03 64/110 630mm^2. The three cable configurations are implemented: single cable in fire-proof box, single cable in vertical protective tube, cables in 3X3 duct banks.