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Development of block molded joint for 275 kV XLPE cable and its application to actual line

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Résumé

La Tokyo Electric Power Co.,Inc. utilise les joints moulés (EMJs) compacts et extrêmement fiables pour les câbles 275 kV XLPE. Cependant,l'emploi de ce joint nécessite un temps d'installation assez long. Pour réduire ce temps, on a donc réalisé le bloc raccord moulé (BMJ). Pour cela, le moulage par extrusion, qui demande beaucoup de temps, est fait à l'usine. Les blocs sont alors expédiés sur le site, où les câbles sont insérés et interconnectés.

Abstract

Tokyo Electric Power Co., Inc. uses the compact and highly reliable Extrusion Molded Joints (EMJs) for 275kV XLPE cable lines. This EMJ, however, requires a long jointing time. In order to shorten the jointing time,therefore, the Block Molded Joint (BMJ) has been developed. In this approach the extrusion and molding which is time-consuming in EMJ is done in the factory. The completed curable polyethylene blocks are then shipped to the site, where the cables are inserted and crosslinked together.

Introduction

The Extrusion Molded Joints (EMJs) have been applied for 275kV XLPE cable lines in Tokyo Electric Power Co., Inc. Since introducing the EMJ in 1989, approximately 1,0 00 joints have been achieved. EMJ is a highly reliable and compact joint with fewer connector parts, because the molded insulation of EMJ is formed by extruding the polyethylene pellets same as the cable insulation, by molding, and then by crosslinking to bond with cable insulation chemically on site. However, it requires the high skills to control the many jointing quality items and the long jointing time of about 30 days per 3 joints on site. Therefore, in order to cope with the increasing use of long-distance XLPE cable transmission lines, it was expected to shorten the jointing time and simplify the jointing quality items on site.

For these backgrounds, by following the excellent feature of the EMJ that has no interface of heterogeneous materials in insulation structure and by appling the polyethylene resin molding technology of EMJ, BMJ has been developed [1] [2]. The curable polyethylene insulation pre-molded block (hereafter called "BLOCK") is made of the same material as the cable insulation in the factory, then the cables are inserted into the BLOCK and crosslinked together on site.

The BMJ has simplified the quality control and skills of jointing work , consequently, has shortened the jointing time by about 40 % compared with EMJ ,because BLOCK is preliminarily manufactured and inspected under a clean and stable environment in the factory, then shipped.

The long-term reliability of BMJ was confirmed in the initial characteristic tests, the 6-months long-term verification test to simulate the actual operating condition and the following characteristic tests. Moreover, as far as workability is concerned, by conducting verification test of fabrication in the conventional EMJ's working space in a full scale model tunnel, it was confirmed that BMJ can be applied to actual lines [3].

Based on these circumstances and verifications, Tokyo Electric Power Co.,Inc. decided to apply BMJ to the short construction period sections in the Kitayono Line connecting Ageo substation (Ageo city, saitama prefecture) to Kitayono substation (Yono city, saitama prefecture). The development, quality control and application to actual line of BMJ is described herein.

Development of BLOCK

Study on BLOCK structure

As shown in Fig. 1, the shape of the BLOCK is primarily classified into separate and cylinder types. The separate type has many interfaces, therefore, requires the development of a crosslinking technique which completely removes the gases existing in each interface and bonds together. While the cylinder type, for which the XLPE shrinkable tube method was reported [4], needs to be bonded using an intervention such as curable polyethylene tape, etc. to fill the gap between cable and tube. With the XLPE-shrinkable tube type it is also difficult to use the same materials with cable. Furthermore, these types require considering the relaxation of electrical stress over the conductor ferrule.

From the above-mentioned comparison, based on the cylinder type which is easy to be fabricated and has fewer interfaces with cable, the curable polyethylene block was designed, which enables crosslinking, and has a high-voltage shielding electrode inside.