MV CABLE UNDER SEVERE MECHANICAL FORCES APPLIED DURING ITS INSTALLATION (CASE STUDY)

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ABSTRACT

Cable pulling and installation is always a concern for contractors and onsite utilities especially in case if the pulling route has a lot of bends, curvatures and slopes for long distance that could exert high pulling force on the cable. One project was having cable installation under severe mechanical forces with a long route duct. A case study has been implemented to determine if the proposed power cable by Bahra Cables Company (BCC) can be pulled successfully through a horizontal directional drilling (HDD) duct. It was required to pull a heavy cable through a decline slope followed by a curvature, and then the cable will be directly pulled in a straight path along 450 meters. Thereafter, the route is followed by another curvature and eventually a ramp up slope.

The challenge in such cable pulling process represents in the requirement of high tensile strength much more than a standard cable to IEC 60502-2 can withstand. A proposed cable design with high tensile aluminium alloy armour was proposed to increase the tensile strength and accommodate the maximum allowable conductor pulling tension. Cable pulling tension was calculated at several cable points throughout its entire route based on relevant standards. The ultimate pulling tension was determined. The calculated total force was found to be high in which it could cause cable damage during pulling.

A simulation to the similar applied tension on site has been implemented through applying a customized test plan includes mechanical and electrical tests for the completed cable sample from the same design. The cable showed an accepted results during application of maximum pulling tension. The results pointed to the possibility of carrying on the HDD cable pulling without failure.

KEYWORDS

Cable installation, pulling route, pulling tension (force), maximum allowable tension, coefficient of dynamic friction, weight correction factor, ultimate pulling force test, partial discharge.

INTRODUCTION

Most of contractors and onsite utilities are taking a high caution during pulling their power cables in order to avoid cable damages. Leading the cable from the reel to the duct entrance or trench is not an easy mission especially when the cable size and weight are high. Prior to pulling the cables on trench for direct burial, the route must be cleared of all sharp stones, wood, glass, or metal debris, the cables have to be laid on a layer of fine sand or soil that is uniformly covered the bottom of the trench. For pulling in duct or conduit, it is important initially to ensure that the duct is smooth, burr-free, and clear of any obstructions that may cause abrasion damage to the cable jacket. This can be carried out by inserting a plug with a diameter equivalent to the internal duct diameter and pulling it through the structure of the duct. Moreover, wire brush or swab is used to remove any foreign objects within the duct. In spite of all these precautions are necessary to be followed, considerations of pulling tensions during installation remain the major concern for any cable laying contractor. Pulling tension should be maintained as low as possible to avoid any cable damage. To accomplish that, an appropriate size of duct or conduit has to be selected. The route of pull should not be very long, having a lot of sharp bends, or inclined route sections. Based on most cable installation standards and manuals, it is well-known that performing a successful pulling process requires that the pulling tension (T) needed to pull the cable through the duct or conduit should not exceed the maximum allowable tension (T_m). The maximum allowable tension is determined by selecting the lesser value between the maximum tension value based on the pulling device and the maximum tension value applied to any part in cable that can bear the pulling force. A decision to perform the pulling process relies significantly on such rigorous calculations besides the other installation factors agreed between concerned parties [1].

In this case study, a challenge has been made to prove the possibility of pulling and installation a medium-voltage cable produced by Bahra Cables Company (BCC) under severe mechanical forces with a long route duct. The pulling route has several bends in addition to inclined plane to up and down. The difficulty to perform such pulling process represents in requirement of high tensile strength much more than a standard cable to IEC 60502-2 can withstand. A cable designed with high tensile aluminium alloy armour is proposed to increase the tensile strength and accommodate the maximum allowable pulling tension on cable conductor. The pulling tension (T) will be calculated to compare it with the maximum allowable tension (T_m) and reveal the possibility of implementing the pulling process.

LAYOUT OF THE PULLING ROUTE

Before commencement in practical calculations of installation parameters applied in this case study, a layout of the pulling route is shown in Fig. 1. Three single-core medium-voltage cables as well as one single low-voltage grounding cable will be pulled partially in PVC conduit in particular sections and in concrete ductbank at pipeline corridor crossing.

TECHNICAL DATA OF PROPOSED CABLE AND USED CODUIT

The proposed cable is a power medium-voltage cable, single core, has circular compacted copper conductor