

70 YEARS OF MV CABLES IN BRAZIL, RELIABILITY OF: CABLES; SPLICES AND POTHEADS

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ABSTRACT

The electrical insulated underground cables have been installed since early 20 in this Country but a massive underground system distribution began in middle 40. In that occasion PILC cables was seen the unique solution until middle of 60 when a lot of EPR and XLPE have been installed till total replacement of PILC cables at the end of 70. As the PILC cables still continue to work at present days even the most of them spliced with EPR and XLPE, one need know how long the PILC cable endure in service in the major cities. This paper treat a large collection of cable failure during the cable life watching the modes of failure and measuring some parameters which given some indication of residual life of the PILC cables..

KEYWORDS

Cables, PILC, EPR, XLPE, Insulated Papers, Reliability

INTRODUCTION

PILC cables can be considered the best cables constructed until this moment, even watching the methods of manufacturing, skilling in splices and potheads and so on. This assessment derives of 70 years of experience and service of this kind of cables in this Country in the worst condition that one can imagine.

Nowadays there is no more a large scale cable manufacture and the Utilities which have this kind of cables maintain PILC cable splicing them with EPR and XLPE cables. The reliability work took a sample of 70 specimens of PILC and EPR XLPE installed along the last 70 years, applying Weibull statistics for time to failure (MTTF parameter). For PILC cable the same treatment have been made for loosing cellulose polymerization in order to measure the kinetics of degradation, while for EPR and XLPE water diffusion have been considered.

This investigation shows that PILC cables can be used for further time instead of to be replaced by solid dielectric cables.

SCOPE OF THE STUDY

AES ELETROPAULO began as Utility in this country at 1899 as *The São Paulo Tramway, Light and Power Company*. In middle 1920 the first underground distributions circuits were installed, but since 1940 a massive underground lines using PILC cables has been installed. After 1970 XLPE and EPR and EPDM cables came to replace PILC cables until 1977, when this type of cable did not any more.

Today AES has 500 km of PILC cables working, but many electrical failures occur and the paramount question is: "It

is possible to maintain the presents PILC cables in service or should we change all of them?"

The aim of this work is to answer this question with scientific basis and in case to continue with in service to develop a method of the preventive maintenance [1].

The aim of this work concerns only in bulk statistics in whole system.

CABLES SPLICES AND POTHEADS

PILC cables have its construction summarized forward: copper (or aluminum) Conductor; double face semiconductor applied above conductor (conductive face in contact with conductor), mass impregnated paper, semi conductive layer, lead sheath and plastic covered.

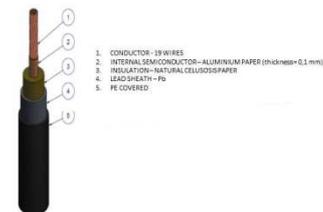


Figure 1

Original PILC cable construction

XLPE cables replace all paper parts of the PILC cables by cross linked polyethylene (even semi-conductive layers). Instead of lead sheath the metallic outer screen is constructed by copper wire tie up by a copper strip, Outer Covering extruded in plastic PE.

EPR cables have the same construction of XLPE ones replacing only cross-linked PE by cross linked EPDM. The figure (2) shows the main features of these constructions.

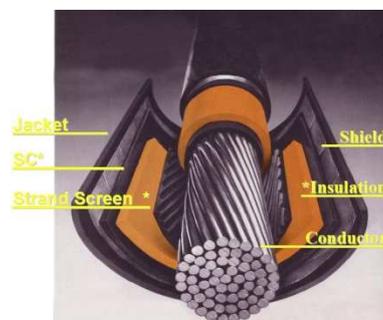


Figure 2

MV CABLES CONSTRUCTION

SPLICES and POTHEADS for EPDM and XLPE cables are the type: Pre molded or Cold Shrinkable, but for PILC