

Development and testing of XLPE-insulated medium-voltage cables with sector-shaped conductors in Russia

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ABSTRACT

The medium voltage cable with stranded sector-shaped conductors for distribution networks is developed. The test results meet the requirements of the following standards: GOST R 55025, IEC 60502-2 and CENELEC HD 620 S2. It is shown that dielectric strength of sector-shaped cable is practically equal to that of circular cable. The application of these cables allows to avoid additional losses in the metallic screens and reduce the cost of cable system installation and operation.

KEYWORDS

cross-linked polyethylene, stranded sector-shaped conductor, 2-year wet ageing, thermal ageing, dielectric strength.

INTRODUCTION

Nowadays cables with XLPE insulation are widely used in electrical power distribution systems. In Russia the most common type of XLPE-insulated cable rated for voltages of 10-35 kV is a single-conductor cable. The production output of this cable type amounts currently to approximately 85 % of the total number of 10-35 kV cables with plastic insulation.

Large outputs of single-conductor cables during the first years of commercial production were driven by the technological capabilities of the cable plants. However, in the recent years due to the fact that the plants are equipped with modern twisting machines commercial production of three-core cables with round conductors has been started. The use of three-core cables leads to a significant reduction of power losses in the metal cable screen, though at the same time there are additional expenses which are associated with a shorter construction length and a higher weight of a three-core cable compared to single-conductor ones. In this regard it seems reasonable to create a series of compact three-core cables with a common metal screen, the use of which will allow the reduction of capital costs for the construction and operation of cable systems.

MV CABLE WITH SECTOR-SHAPED CONDUCTOR DESIGN AND TEST RESULTS

At present the power grids in Russia consist of cable systems that are primarily composed of XLPE-insulated cables and cables with impregnated paper insulation. In spite of obvious disadvantages of the latter cable type they are still widely used due to their lower cost. In 2018 the size of consumption of impregnated paper-insulated cables for voltages of 10-35 kV was approximately 50% of the total amount of cables for this voltage rating.

In order to reduce the cost of three-core XLPE-insulated cables and the cable system installation expenses the authors developed 10 and 20 kV three-core cables with

sector-shaped conductors.

Typical constructions of 10 kV cables with round and sector-shaped conductors are shown in Figs. 1 and 2.

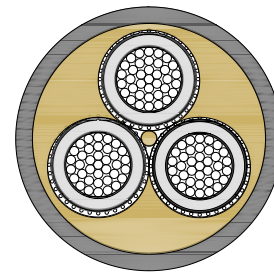


Fig. 1: Construction of a 10 kV three-core cable with round conductors

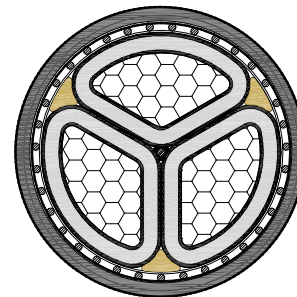


Fig.2: Construction of a 10 kV three-core cable with sector-shaped conductors

In the developed cables, as in the three-core cables with round conductors, there is practically no current in the metal screen during normal operating mode. These cables have a smaller weight and smaller overall dimensions, as well as a longer construction length in comparison to three-core cables with round conductors.

The comparison of weight and dimensions of 10 kV single-core and three-core cables with round and sector-shaped conductors is given in Table 1.

Table 1
Comparison of weights and outside diameters of 10 kV XLPE-insulated cables of various designs (240 mm² conductors)

Parameter	Cable type		
	3 single-core cables	Three-core cable with round conductors	Three-core cable with sector-shaped conductors
1. Cable weight, kg/km	4884	6461	4161
2. Outside cable diameter, mm	77.8*	75.2	61.8

*) diameter of a circle circumscribed about three single-core cables laid in close contact in a trefoil formation

As may be seen from the data in Table 1, the weight of a