



## MODERN CABLE SYSTEMS IN STEEL PIPES –

### New designed XLPE-insulated cables substituting paper-insulated pipe type cables



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#### ABSTRACT

*A lot of paper-insulated pipe-type cables are in service until now. The major part of them is still in good condition but some may also have to be replaced in the near future due to aging of the cable insulation or of the steel pipes. In many cases the steel pipes show only local defects and are suitable for further use. For these “retrofitting” Nexans has developed a new diameter-minimized three-core XLPE-insulated high voltage cable system with strongly reduced insulation thickness, that can be pulled into the existing pipes. The design of the cable and the accessories is presented in this paper. Before market introduction an extensive test program - type test and one year long term prequalification test with increased voltage and thermal load cycles adapted to IEC62067 - was performed to demonstrate the feasibility of the new cable system. The determination of the residual electrical strength of cable and accessories after the long term test does not give any indication of ageing and showed excellent results.*

*Practical experience in the field is presented by an exemplary project in the network of a major utility in Germany for the retrofitting of 110 kV external-gas pressure cables.*

#### KEYWORDS

Three-core XLPE-insulated HV cable, reduced insulation thickness, retrofitting of pipe-type cables, long term test.

#### INTRODUCTION

At the early beginning of installation of XLPE-insulated power cables in HV networks of 60 kV and above the electric design was quite conservative. A large thickness of polymer insulation led to a moderate electrical field strength at the conductor screen as well as in the interface to the cable accessories.

Even today the majority of new installations in the 110 kV network of German utilities still maintain an insulation thickness of 18 mm as from the beginning. Excellent service experience with this cable design for about 30 years as well as extended application of XLPE-insulated cables in the higher voltage levels up to 500 kV together with improved production processes and high grade materials do however meanwhile allow a significant reduction of the insulation thickness.

As a result, the cable design gets more compact with a remarkable smaller overall diameter, which gives the possibility to lay-up 3 complete power cables of 60 kV to 110 kV voltage level in the factory. A flat steel armouring applied over the assembly at a still acceptable total diameter of the cable gives the opportunity to apply the cost and time efficient cable laying technology for 3-core high voltage cables. The main application of this cable design can be seen for the installation of new cable systems in pipes in crowded urban or industrial areas as well as the replacement of old pipe-type cable systems with impregnated paper insulation like gas pressure cables or oilostatic cables.

This publication describes a new designed XLPE-cable system for retrofitting of 110 kV gas-pressure cables widely used in Germany.

#### 1. DESIGN OF THREE-CORE XLPE-INSULATED HV CABLE

Target of the development of this new cable system is a 3-core stranded XLPE-cable with an overall steel armouring for laying in pipes made of e.g. steel, concrete or plastic. Well proven construction elements of traditional pipe-type cables are used. Each individual cable has a full-size design with longitudinal and radial watertight sheath (aluminium laminated sheath) including a copper wire screen. The conductor may either be of round stranded or solid copper or aluminium. During stranding of the 3 cables the interstices are filled. An armouring of flat steel wires is applied over reinforcement tapes and fixed by a steel counter helix. This counter helix is removed before pulling the cable into pipes. Optionally fibre optic cables for online temperature monitoring or data transmission can be introduced into the interstices as well.