Retrofitting HV External Gas Pressure Cable Systems

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ABSTRACT

In the Netherlands, TSO TenneT has the intention to replace the 110 kV and 150 kV external gas-pressure cable systems for the coming years with extruded cable systems making use of the existing steel pipe infrastructure, so called retrofitting.

This paper describes the development for a 150 kV retrofit cable system, compatible with the External Gas Pressure cable system as existing in the Netherlands, and comprises description of the cable designs, production of pilot lengths, report on real-scale pulling tests, type test, PQ test and other tests.

KEYWORDS

External Gas Pressure cable, EGP, Extruded cable, Retrofitting, Pulling, Type Testing, HV

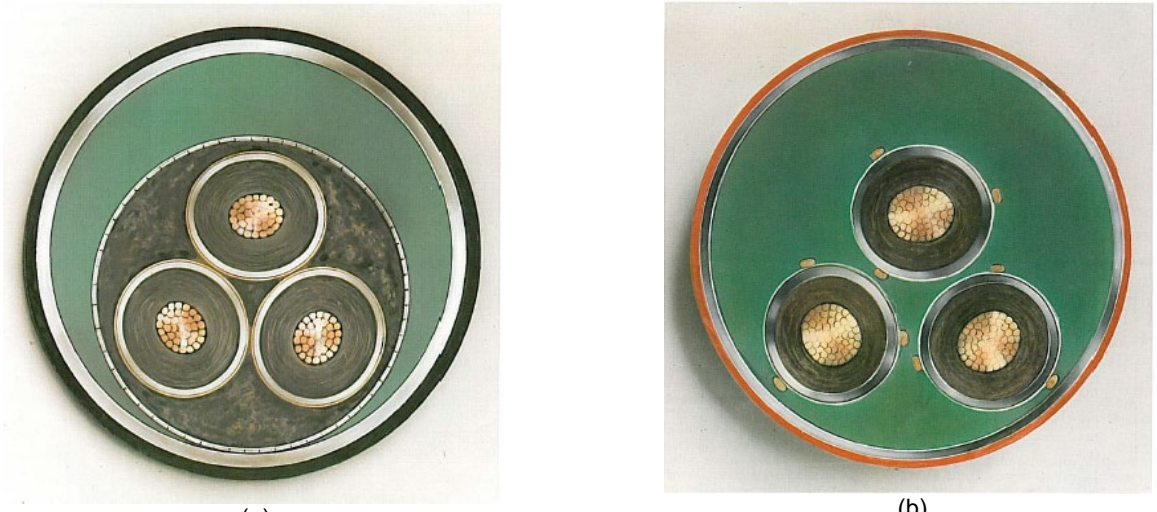
INTRODUCTION

Around the world the backbone of underground electricity transmission has been borne by paper insulated cable, generally operating between 33 kV and 400 kV, some of which are still in service since the 1930's [1]. For new connections, this paper insulating technology has largely been superseded by XLPE type cables because the use of extruded cable systems for transmission and distribution circuits is ever increasing at the expense of LPOF (Low Pressure Oil Filled), HPFF (High Pressure Fluid Filled), EGP (External Gas Pressure) and MI (Mass Impregnated) cables. Furthermore the number of manufacturers of these LPOF, HPFF, EGP and MI cables is decreasing and therefore the availability of such cables for repair works or re-routing is limited and it is going to be even rarer in the future.

In Europe, a considerable number of HV EGP cable systems are still in service today at HV level (110 kV and 150 kV) and EHV level (230 kV). In the Netherlands, two types EGP systems have been installed in the seventies and eighties (Figure 1):

- Three core Paper Insulated Lead Covered cores with paper fillers and flat steel wires armouring and
- Single core Paper Insulated Lead Covered cores with skid wires.

Both types were pulled into pre-installed cladded steel pipes. The free space between the cable and steel pipe is filled with Nitrogen and pressurized to ~ 15 Bar in order to avoid ionization of the impregnated paper insulation under all operating conditions (due to the compressive effect on the oval-shaped lead sheath covering the core).



(a) (b)

Figure 1 'cross sections of the classical UGD cable system, including steel pipe: the 3core design (a) and 1C design (b)'

The Dutch TSO TenneT has the intention to replace a majority of this type of EGP cable systems with extruded cable circuits in the coming years because of:

- end of lifetime of the EGP systems,
- longer repair time of EGP
- limitation in power rating because of downscaling operating temperatures of existing links (due to aging or changing thermal surroundings of the cable link).