TRANSITION TECHNOLOGIES FOR HV-CABLE SYSTEMS

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ABSTRACT

Technical solutions are needed to allow repair or re-routing works on paper-insulated HV cables without having spare cables of the original design. An increasing demand for a "real" transition joint becomes visible in the market to connect modern XLPE-insulated cables to paper-insulated fluid-impregnated cables of the different types (LPOF, HPOF, external gas-pressure, internal gas pressure).

The design of XLPE-insulated HV and EHV cable systems have changed over the last 30 years as modern production lines and today's high-graded materials allow an optimization of the cable insulation system. Increasing demand for power transmission leads to new conductor designs and conductor sizes with an impact on the metallic sheath/screen construction, too. Thus maintenance and rerouting of older polymeric insulated cable systems requires a "transition" to new XLPE- cable designs and needs suitable transition technologies to connect cables of the different generations.

An overview over the different "real" and "hidden" transition joints is given in the report.

KEYWORDS

Paper-insulated fluid-impregnated cables, XLPE-cables, transition joint, conductor connection.

INTRODUCTION

The availability of new paper-insulated fluid-impregnated cables will end in the near future as the production facilities will be not available much longer. Also the amount of such cable kept on stock is limited. For this reason repair and rerouting activities in the paper cable network can only be done by using new XLPE insulated cables. An increasing demand of "real" transitions joints for this application is envisaged justifying the development and qualification of modern design transition joints.

Also the design of XLPE-insulated HV-cables has changed over the last 30 years. When connecting cables of the different decades hidden transitions joints are needed to accommodate the individual design features of such cables.

1. Transition joints for cables with lapped insulation

1.1 Present situation

A lot of paper-insulated fluid-impregnated high voltage cables (lapped insulation cables) are still in service today building the major part of the power transmission and distribution network in the urban areas. The cable dielectric is built either out of Kraft paper or PPLP (polypropylene laminated paper). In combination with an insulation fluid (oil or gas) a highly reliable insulation system is formed.

The different generic designs of such cables are shown in **table 1**.

Cable type	Core no.	Insulation	Impregnation	Voltage level
LPOF	1	paper	oil	60 - 500 kV
LPOF	3	paper	oil	36 - 132 kV
LPOF	1	PPLP	oil	275 - 500 kV
HPOF	3	paper	oil	132 - 330 kV
GC	3	paper	mass	110 - 132 kV
GFC	3	paper	mass	110 - 132 kV

LPOF : low pressure oil filled cable
HPOF : high pressure oil filled cable
GC : gas pressure cable
GFC : gas filled cable

Table 1: Generic design of lapped insulation cables

The number of cable plants able to produce such cables is worldwide decreasing, the availability of these cables will end in the near future. Spare cables kept on stock will only allow a few repair activities, too. With this background the number of transition joints between the old lapped insulation cables and new XLPE-insulated cables will increase accordingly.

1.2 Transition joint designs

In the past the transition from lapped insulation cables to polymer insulated was needed in a few case only, e.g. for looping in into new GIS-stations. As the number of applications did not justify special development a connection based on the stop-joint design for oil-filled cables was used, replacing one side of the joint by a termination for polymer cables. An example of single core design is shown in **picture 1**, a 3 core design is shown in **picture 2** [**1**].