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A.4.4. Développement de jonctions monoblocs prémoulées pour les câbles HT et THT

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A.4.4. Development of HV and EHV single piece premoulded joint

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RESUME

Le raccordement des câbles à isolation synthéthique à l'aide de jonctions prémoulées monobloc est un concept déja ancien.
Les études relatives à son adaptation aux tensions supérieures à 132 kV et jusqu'au trés haute tension sont encore limitées.
Nous présentons le developpement d'une jonction monobloc EPDM pour le niveau 225 kV, en explicitant le choix du materiau retenu et les principaux paramètres de dimensionnement.
Les modélisations nécessaires à la maitrise compléte du développement sont décrites.
Nous rapportons les résultats pratiques et enseignements obtenus pendant les essais électriques des jonctions prototypes.
L' extension du concept premoulé monobloc aux niveaux 400 kV et au dela est examiné

ABSTRACT

The jointing of synthetic insulated cables with one piece premoulded joint is already an old concept.
The studies regarding its use for voltage above 132 kV and up to the very high voltage are still limited.
The development of a one piece EPDM premoulded joint, at 225 kV level, is presented, high-lighting the choice of the selected material and the main design parameters.
The models necessary to master the development are described.
Practical results and experiences gained from the electrical tests on prototype joints are reported.
The extension of the concept of single piece premoulded joint up to 400 kV and higher is considered.

1- Introduction

Polymeric insulated cable is well underway to take over the lead from the conventional oil impregnated paper cable for transport of bulk electric energy at high voltages because of its simpler design and manufacturing process and relatively uncomplicated accessories. Such a cable system is easier to install and virtually maintenance free during its service life.
Among the accessories for high voltage polymeric cable system, joint has been the weak link due to its number of components, too much dependence on the skill of the jointers, and long construction time. Commonly used joints are taped joints of different types, however, in recent years other jointing techniques are successfully introduced at least for voltage up to 123 kV. Beyond this voltage, taped joints are still the most prevailing type although new techniques are being evaluated as experiences gained from these installations. Table 1 shows typical jointing methods presently used.

table 1: Jointing technique and material used for XLPE cables

Joint type	Voltage (kV)	Jointing material
Tape (self amalgamating)	69 - 150	XLPE, EPR
Tape moulded	110 - 400	XLPE, EPR
Field moulded	110 - 275	XLPE
Prefabricated-composite	150 - 275*	epoxy - silicone
-premoulded	69 - 150	EPDM, silicone
-premoulded	225*	EPDM

* System under evaluation

The principle of taped jointing techniques for XLPE cable are spill over from paper cable which require very experienced and skilled jointers, a clean room at the jointing site and a long time consuming process. Other than short time DC test at relatively low voltage after installation these type of joints can not be pre tested before service and thus their quality can not be predetermined. These reasons have led electric utilities to seek prefabricated joints to improve their service reliability, to shorten jointing time and to reduce the size of cable manhole.
There are several concepts of prefabricated joints and premoulded is one of them. Being simple in concept and construction, a premoulded joint can be pre tested and each step of its manufacturing phases in the factory can be controlled for quality assurance. As other prefabricated types can not be easily manufactured and pretested, one piece premoulded concept is a preferred option for high voltage application.
Premoulded joints for medium voltage are available for over 30 years and have excellent service records. But use of this technique for high voltages is no more than a decade old and has been limited until now largely to 132 kV applications and some field trials at higher voltages. This is because with higher voltages the size of a premoulded joint becomes bulky and problems associated with it during manufacturing of these joints become critical as does the choice of material. This has led to a situation such that the potential of premoulded jointing technique for higher than 150 kV is not yet adequately investigated nor its practical limits are established.
High voltage joint is composed of a joint body and an outer protective cover. Performance of a complete joints is a combination of these two equally important components. In this paper the development of a 225 kV one piece premoulded joint body and concept of its outer protective cover is described

2- Choice of material

A premoulded joint requires an elastomeric material that is flexible and electrically, thermally and mechanically compatible to polymeric cables. Among the different types of elastomeric compounds, EPDM and silicone are better suited for premoulded joints and at present both types are used, although the use of EPDM is more widespread. EPDM is a very versatile material and the choice of its ingredients can be closely matched to the requirements. It is compounded and controlled for quality by the joint producer. Whereas silicone, the RTV type that is generally used for cable accessories, comes in two components from large chemical companies where there is a less option for modification. High voltage applications require a careful and objective selection of material on the basis of properties and requirements. When properly formulated, EPDM and possibly silicone would be suitable for EHV joints but considering a) the excellent service records of 132 - 150 kV EPDM joints, b) relatively smaller joint dimensions required for EPDM compared to silicone because of its higher dielectric strength, and c) the means to optimise EPDM ingredients and control of its quality, EPDM is chosen as the material for 225 kV premoulded joint development. Typical properties of EPDM and silicone compounds are noted in table 2