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A.4.3. Les extrémités extérieures et les extrémités incorporées pour les câbles synthétiques jusque 400 kV

GAHUNGU F., Alcatel Cable, Calais, France
DELCOUSTAL JM., GEC Alsthom, Aix-les-Bains, France
BROUET J., Alcatel Contracting, Clichy, France

Sommaire :

Ce rapport concerne les extrémités pour les câbles synthétiques extrudés :

- Extrémités type extérieur : le câble équipé d'un déflecteur de champ est introduit directement dans la porcelaine

- Extrémités sèches : fonctionnent parfaitement sur les réseaux 63 kV et 90 kV dans les postes modulaires en France et sur des liaisons temporaires 150 kV à l'étranger.Les résultats d'essai à 225 kV sont encourageants.

- Extrémités incorporées : le câble équipé d'un déflecteur est soit introduit d'abord dans un isolateur de séparation ou directement dans la boîte à câble des postes blindés.

- Cet article est illustré par des exemples d'essais ou d'installations, et particulièrement par une boucle 400 kV comprenant : un câble PR, un poste blindé et d'une extrémité type extérieur, qui utilisent les derniers développement technologiques.

A.4.3. Outdoor and incorporated terminations for extruded synthetic cables up to 400 kV

GAHUNGU F., Alcatel Cable, Calais, France
DELCOUSTAL JM., GEC Alsthom, Aix-les-Bains, France
BROUET J., Alcatel Contracting, Clichy, France

Summary :

This report concerns terminations for extruded synthetic cables.

- Outdoor porcelain terminations. The cable terminations equipped with stress cones are inserted directly into the porcelain insulators.

- Dry terminations : they function satisfactorily in indoor modular 63 and 90 kV substations and in 150 kV temporary cables connections. Test results at 225 kV are encouraging.

- Incorporated terminations: the cable terminations equipped with stress cones are inserted either into epoxy separation insulator, or directly into the GIS terminations enclosures.

- This article is illustrated by examples of tests carried out on installations, and in particular by a complete 400 kV test loop comprising : XLPE cable, complete GIS system and outdoor porcelain termination using the latest technological developments.

1/ INTRODUCTION

The history of insulated cables and their associated connection systems started a hundred years ago. It was essentially in the fifties and sixties that the insulated "synthetic" systems developed considerably compared to the insulated "paper" systems.

However, a HV or EHV system can only be made reliable by ensuring total control of the inseparable "cable-accessory" pair. The accessories are essential, and are the crucial point in the network. Their inherent reliability must at least equal that of the connected cables. Accessories in general and terminations in particular are subjected to the same thermal and electrical stresses as the cables. Usual current insulations are : cross-linked polyethylene, thermoplastic polyethylene or EPR.

Outdoor terminations are occasionally subjected to extreme environmental conditions : industrial, petrochemical and marine pollutions. GIS terminations however are not subjected to atmospheric environmental conditions. The electrical field distribution is radial in HV and EHV cables, and is perturbed in the terminations if the cable external screen is removed, a field control system is thus indispensable.

2/ RELIABILITY

The cable/accessories system and the terminations in particular are industrial products manufactured in a factory and assembled at the site of installation. The numerous tests carried out on the cable and its terminations make it possible to assess its short and long duration reliability [1] [2] [3] [4] [5] [8].

3/ STATE OF THE ART

Power generation plants are generally located away from industrial and urban consumption. The energy generated from several plants is carried by EHV transportation lines that converge towards coupling and/or transformation points called "substations". These are described as « air insulated substations or AIS »,if all or most of the insulation between live parts and earth is provided by air at atmospheric pressure [16] . In this case the terminations of the insulated cables are the outdoor type. They are described as "Gas insulated substations or GIS " if all or most of the insulation is provided by a gas operating above atmospheric pressure within an earthed metal enclosure [16]. GIS technology is well adapted to the combination of overhead lines, insulated cables and gas-insulated links, in voltage ranges between 63 kV and 400 kV or higher.

3.1/ Outdoor terminations

In the HV and EHV up to and above 400 kV, porcelain terminations have proven their reliability. They are used not only outside buildings but also in air insulated substations. The use of pre-molded stress cones designed from field calculations by computer has become widespread. The performances achieved are remarkable. The practical development of these assemblies is also based on experience acquired at lower voltages levels.

In these materials the stress cone is slid over the cable insulation once the external conductive screens have been removed.

The cable termination assembly is inserted directly into the porcelain insulators [1][9].