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Influence of some selected service conditions on properties of XLPE applied in insulated or covered overheads conductors

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Abstract: Insulated or covered overhead lines are an alternative for bare conductor lines. Insulation of overhead conductors is exposed to many more various degrading factors than cable insulation (moisture, UV radiation, large changes of ambient temperature, surface discharges, toxins, abrasion, etc.).

Five kinds of samples were investigated. In each case the basic material was crosslinked polyethylene. Samples differed by the kind and amount of additives.

Keywords: insulated overhead line, crosslinked polyethylene, surface resistivity, hardness, wetting angle, migration of moisture

Résumé:

Les conducteurs aériens isolés avec ou sans gainage sont une alternative aux conducteurs aériens nus. L'isolant des conducteurs aérien est exposé à beaucoup plus de divers facteurs dégradants que l'isolant des câbles souterrains (humidité, rayonnement ultraviolet, grands changements de température ambiante, décharges superficielles, toxines, abrasion, etc....)

Les auteurs ont examiné cinq types de matériaux utilisés comme isolant ou gainage de conducteurs aériens. Les matériaux sont principalement composés du PRC. Ils se différencient par le type et la quantité d'additifs.

Mots clés: conducteurs aériens isolés, polyéthylène réticulé, résistivité superficielle, dureté, angle de mouillage , migration de l'humidité

1. Introduction

Insulated overhead lines are an alternative for bare wire lines. Although the cost of their laying is higher than that of bare lines, in some situations – e.g. lines crossing forests or wildlife reserves, strongly polluted atmosphere, extreme atmospheric conditions – lower operational costs [1] and higher power reliability are in favor of the insulated lines. In addition, lines of this type withstand similar or even heavier mechanical load than lines used in traditional technologies. It is also relevant that the overall dimensions of overhead lines can be reduced [2,3], which makes them more attractive as far as economic, ecological and technical aspects are concerned.

Insulated overhead lines were introduced in Europe as early as in the 1950s. An analysis of insulated overhead lines' development in Poland shows that in the range of low voltage an increased interest in these lines was noticed after 1990. In the case of medium-voltage insulated overhead lines, a similar interest has been observed since 1992 [4]. At present, new insulated overhead lines are utilized in Distribution Companies every year and their total length is growing significantly higher. Expected benefits of operating insulated overhead lines become verified by operational experiences. A thorough analysis of insulated medium-voltage overhead line failure frequency has shown that the very low percentage of failures can be classified as damages related to ageing in insulation – conductors cover [4]. However, one should be aware of a relatively short operational life-span of this kind of overhead lines. In order to avoid service problems in the future, it is necessary to estimate the effects of specific ageing factors on the quality of crosslinked polyethylene during its many-year usage in the power network. Insulation of overhead lines is exposed to many more various degrading factors than cable insulation (moisture, UV radiation, large temperature amplitudes, surface discharges, toxins, abrasion, etc.). [5].

2. Requirements for overhead lines' insulation

Service experiences show that most cases of insulation damages in insulated medium-voltage overhead lines result from line-to-line faults, which are brought about by falling trees or branches. One special case is when tree branches fall next to terminals fitting arc-protecting equipment – fig. 1. As a result, surface discharges appear on insulation (shield) surface. This, as such discharges produce durable, burned conducting paths, leads to surface