A.4.5. Analyse de défaillances génériques sur des jonctions rubanées 110 kV pour câbles à isolation polyéthylène réticulé

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Résumé

Les câbles à isolation polyéthylène réticule sont une alternative fiable et éprouvée aux lignes aériennes de 110 kV. Peu après la mise en service d'une liaison par câble de 110 kV, une série de défaillances sur des jonctions rubanées de câbles venant d'être installés nous a toutefois donné i'impression contraire. La méthode de localisation des défaillances, l'importance et la cause des défaillances seront expliquées en détail. Pour finir, une alternative à ces jonctions rubanées sera envisagée et comparée.

A.4.5. Failure series analysis of wrap type cable joints on a 110 kV XLPE cable system

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Abstract

The XLPE cable is a proven and reliable alternative to the 110-kV-overhead transmission line. Shortly after the setting into operation of a 110-kV-cable section a series of breakdowns of the tape-wrapped joints of a newly constructed cable section left an opposite impression. The method of failure localization, the extent and the duration of the failure corrective action as well as the measures taken in order to determinate the cause of trouble are described in the following. Finally the realized joint technique is opposed to an eventual alternative.

General

The Vorarlberger Kraftwerke AG, an electric supply company in Western Austria, operate a low, a medium and a high voltage transmission system. In order to increase the security of the supply in the 110 kV-system a project with the aim to realize a 110-kV overhead transmission line connecting the power substations Vorderwald and Weiler was elaborated as early as in 1985.

As the realization of a 110-kV overhead transmission line meant an interference in the landscape of the respective rural area, there was an opposition of the population against the said project. The project was revised and the revision resulted in the elaboration of an alternative, which was based on a 110-kV cable system. For geological reasons a short partial section was realized as an overhead transmission line, an other section had already been realized before in the overhead modus. The 15,5 km total length of the planned 110-kV transmission line comprised a section of 12,1 km as 110-kV cable system in XLPE technique.

A main reason why the cable system was realized with XLPE cables was the fact, that this technique was proven and reliable.

After a short while the project of this transmission line was assured as legal agreements were made with the landowners of the fields affected by the line routing and the approvals were granted by the authorities. The realization of the transmission line began in spring 1993.

The 110-kV cables were designed with a conductor cross-section of 500 mm², a sheath cross-section of 50 mm² and in correspondance with the provisions of the DIN VDE 0263 [1;2] The laying of the XLPE underground cables was realized in a trefoil formation in a layer of sand. The sheaths of the cables were earthed on both sides and connected through the joints.

The laying of the cables was realized in sections of a length of 700 to 800 m each, which resulted in 16 partial sections for the total length of 12,1 km.

At site the cable producer mounted tape-wrapped joints with self-bonding ethylene-propylene-rubber tapes (EPR) serving as insulation. This joint technique is often employed in 110-kV cable systems as it represents an economic solution [3].

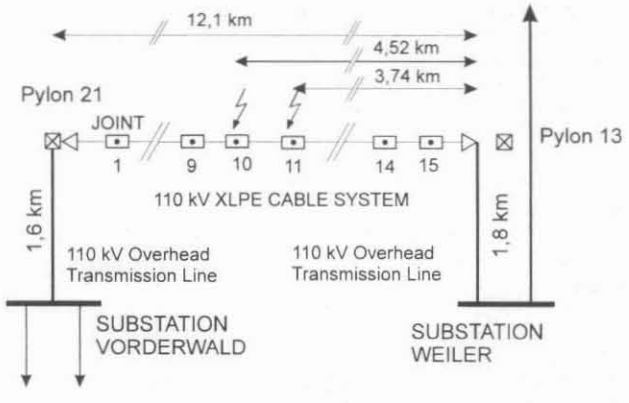

Figure 1: Block diagram of the 110-kV-transmission line

The outdoor sealing ends of the cable section on the transmission towers 21 and 23 were protected by a system of metal oxide arresters (MO). After the completion of the mounting works the cable system was tested according to the provisions of DIN VDE 0263 or IEC 840 with a direct current voltage of $3xU_0$=190 kV during a testing phase of 15 minutes.

A series of breakdowns of the joints

First breakdown during normal operation

Four weeks after the setting into operation an earth