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Design of single core cable installations exposed to short-circuit stresses

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Abstract: Single core cables and terminations are subjected to combined electromechanical and thermo mechanical stresses at short-circuit conditions. A draft (prEN 50368) concerning cable cleats, which is submitted to CENELEC enquiry, consider short-circuit testing of cable cleats. The draft does not give practical recommendations.

This work has been supported by cable manufacturers, fabricators of cleats, industry and power utilities.

The test results show that the design of the cleat is essential in order to ensure safe operation of the cables. Full scale short-circuit testing of cable runs consisting of cables, cleats and supports is necessary for design of cable installations.
The operation philosophy of the installation must be clarified. The installation can be designed to withstand one fault, several faults without repair or it may be acceptable to replace the whole installation.

Keywords: short-circuit, electro mechanical, cable

Résumé: Les câbles unipolaires et les extrémités sont soumis à des contraintes électromécaniques et thermomécaniques combinées lors de conditions de court-circuit. Un article sur les ancrages (prEN 50368) rédigé à la demande de CENELEC considère l'essai d'ancrage en conditions de court-circuit mais ne donne aucune recommandation pratique. Ce travail a été supporté par des fabricants de câble, d'ancrage et des compagnies d'énergie.

Les résultats d'essais montrent que la conception de l'ancrage est essentielle au bon fonctionnement du système de câble. Ainsi, des tests grandeur nature en condition de court-circuit de l'ensemble câbles, ancrages et supports sont nécessaires à la fois au développement de ces composants et à la conception et au dimensionnement du système de câble complet.
La philosophie de fonctionnement de l'installation doit être claire. L'installation peut être conçue pour supporter un défaut, plusieurs défauts sans réparation ou bien il est acceptable de pouvoir changer l'ensemble de l'installation.

Mots clés: court-circuit, électromécanique, câble

1. Introduction

Cable installations must be built to withstand the thermo-mechanical and electromagnetic forces during short-circuit. To ensure an acceptable overall reliability for installations without too high costs, these stresses have become increasingly important due to higher short-circuit capacity at all voltage levels.

Because of the complex nature of the response when a cable installation is exposed to short-circuit currents, theoretical models and calculations have obvious limitations. Full-scale tests are needed to increase the understanding of stresses and the response of components involved. The stresses are most severe for compact configurations with single core cables. Tests shall confirm that the design of the cleats is essential to ensure a safe installation. There are a variety of cleats for trefoil installations.

Several manufactures of support systems have performed full scale testing for design of cable installations.

The characteristics of the cable itself are also important in relation to short-circuit stresses. Cable data includes maximum short-time conductor temperature. However, little information is available concerning acceptable pressure, bending radius etc. in order to prevent mechanical damage and reduction of the electric withstand capabilities of single core cables. The highest short-circuit currents occur at low voltage installations. However, calculations have shown that in some high voltage installations for some cases the peak short-circuit current may exceed 100 kA.