FIRE PERFORMANCE OF HIGH VOLTAGE CABLES

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ABSTRACT

The paper describes experimental work to evaluate the reaction to fire properties of high voltage cables protected with different metallic shields and sheathing materials. The purpose of these tests was to establish if cable designs utilising more fire retardant materials provide a significant improvement compared to the performance of previously reported non fire retardant types.

KEYWORDS

Fire; Retardant; Reaction; FIPEC; Dripping; Oversheath; Metallic.

INTRODUCTION

With increasing demands for cable circuits in densely populated areas there is a clear tendency to install high and extra high voltage cables in tunnels. A significant concern is the fire safety of these cables, since it is often not practical for fire protection services to give a rapid response in the case of fire. This subject has been addressed in the Technical Brochure prepared by Cigre on cables in tunnels containing shared services[1].

The consequences of an XLPE insulated cables catching fire in a tunnel have been well documented[234]. In 2007 Philippczyk et al[5] demonstrated the development of fire for a HV XLPE cable with a HDPE oversheath and laminated aluminium foil screen installed in a tunnel like enclosure. Whilst it is possible to bury some of the more hazardous cables in the floor of the tunnel, provide protection barriers or install fire protection systems such as water sprays or other devices, these systems are all expensive. It was therefore considered important to establish if more suitable cable designs could provide an adequate level of fire protection without the need for separate protection systems.

The problem with the cable design mentioned above was due to the HDPE providing significant fuel to the fire. It is clear that the aluminium foil laminate would provide only limited protection and would eventually fail and allow the fire to attack the underlying XLPE. The current paper describes experimental work to evaluate the performance of high voltage cables protected with different metallic shields and sheathing materials having greater fire retardant properties. The purpose of these tests was to establish if these designs provide a significant improvement over that reported at Jicable 2007.

EXPERIMENTAL

The cables were tested according to the same FIPEC horizontal reference scenario[6] as described previously. This had been chosen as a representative method for the testing of cables installed within corridors/tunnels.

Figure 1: Experimental set-up for fire performance testing of EHV cable

The experimental set-up is shown (Fig. 1). It consists of a corridor configuration with no forced ventilation. The cables are mounted on three horizontal ladders. A diffusion flame burner (sand box) is positioned at one end, below the lowest ladder with the flame directly impinging on the lower horizontal cable tray. The fire performance of the cables can be assessed by following the flame spread. The progression of the fire follows 3 steps – ignition of the cables immediately above the burner, flames spread along the top cable closest to the roof of the test cell and final flame spread from the upper cable to those below due to radiant heat and/or dripping. Although there is no applied ventilation, the convective airflows engendered by the fire are important.

Initially a fire load of 40kW is applied for 5 minutes. Subject to certain criteria, the burner is then increased to 100kW for a further 10 minutes. Again subject to criteria the final stage is a further 10 minutes at a fire load of 300kW. In general cables which fail the criteria for increasing the fire loading do so as they are in the process of demonstrating a runaway fire growth where heat release will rapidly increase to the maximum capacity of the cell (1,5MW). There is no formal criteria for the classification of data generated according to this test method. The target is to identify the likely cable performance when subjected to the defined fire loads.

Four different high voltage cable designs with different fully sealed, welded or extruded metal undersheaths were selected for this study. Different combinations were used to cover all the aspects of cable design. The metallic under sheaths were extruded lead alloy (LA), corrugated stainless steel (CSS), corrugated copper (CC) and corrugated aluminium (CA).