# Fire hazard of MV/HV cables installed in tunnels

Christian PHILIPPCZYK, NKT Cables Gmbh, 51063 Köln, Germany, christian.philippczyk@nktcables.com
Keld VENO-POULSEN, NKT Cables A/S, 4550 Asnaes, Denmark, Keld.Veno-Poulsen@nktcables.dk
Terry JOURNEAUX, Prysmian Cables & Systems, Eastleigh, SO50 6YU, UK, Terence.Journeaux@prysmian.com
Doug GRACIAS, Prysmian Cables & Systems, Eastleigh, SO50 6YU, UK, Doug.Gracias@prysmian.com
Wendy LOYENS, Borealis AB, 44486 Stenungsund, Sweden, wendy.loyens@borealisgroup.com
James ROBINSON, Borealis Polymers NV, 2800 Mechelen, Belgium, james.robinson@borealisgroup.com

## *ABSTRACT*

*The fire performance of MV and EHV cables in a tunnel fire has been demonstrated using a modified FIPEC horizontal reference test scenario. The results revealed that a cable tunnel fire can have catastrophic consequences. An EHV cable without flame retardant technology exhibited a dramatic fire growth rate with very high heat release. In a real tunnel installation fire fighter access would be impossible and the fire would consume completely the installed cables. The heat release would result in severe structural damage. In contrast, it can be demonstrated that the potential risks might be largely mitigated by the use of sheathing materials with improved reaction to fire performance for the outer layer of the cable.*

## *KEYWORDS*

Tunnel fire, flame retardant, FIPEC horizontal reference scenario, EHV, HV, MV

## INTRODUCTION

The principal issues when studying the cable tunnel fire scenario are the risk of such an event occurring and the resulting human and economic losses. Basically, the risk can be deemed as very low. However, as can be seen from the examples below, on the occasion that a fire does occur the consequences will often be catastrophic. Risk and prevention becomes a delicate balancing act.

In recent years, tunnel fires in both road tunnels and rail tunnels have claimed the lives of many people. In addition, they have caused severe structural damage and resulting economic loss. The fire in the Mont Blanc road tunnel (France/Italy - 1999) cost the lives of 39 people and caused severe structural damage resulting in a closure of the tunnel for 3 years. A similar scenario was seen from the St. Gotthard road tunnel fire (Switzerland - 2001), claiming 11 deaths and severe damage to the tunnel, with closure for 2 months. The most recent big road tunnel fire (France – 2005) in the Fréjus road tunnel left 2 people dead and 21 injured while 10 km of equipment needed to be repaired.

Besides the possible loss of human lives, the structural damaged caused by a fire can be devastating. The corrosive impact of the fire gases can cause serious malfunctioning of other utilities present, thereby initiating major service disruptions, e.g. power outage, loss of communication etc.. Fire-related non-thermal damage can be categorised according to various criteria. There is the time-scale aspect relative to the fire event such as short term and long term effects of corrosion caused by combustion products. The nature of the exposed materials and their sensitivity towards heat and effluent composition plays an important role in fire development. Within a cable tunnel the essential components are the metal and/or concrete infrastructure and the cabling [1].

An EHV cable typically has a heat capacity of 1000 MJ/m. Fires involving such cables can develop very high energy releases (150 – 600 MW) causing severe damage and rendering futile any effort to extinguish the conflagration. The materials used in the construction and contents of the tunnel are a crucial parameter determining the severity of the fire and the resulting tunnel damage [2].

Our paper concerns the consequence of a fire in an underground EHV or HV cable tunnel. Such a fire is unlikely to involve people and so here the principal concern is loss of function and physical damage. However it will become clear that fire behaviour and prevention are key issues when dealing with power cable tunnel installations. The paper reports the study of the fire performance of MV and EHV cables in a tunnel fire simulated using the FIPEC horizontal reference scenario test set-up. The main focus will be on the effect of using sheathing materials with improved reaction to fire performance (FR) for the outer layer of the cables.

## EXPERIMENTAL

### Materials

The test programme focussed on the performance of EHV and MV power cables. Five different cables were tested. Their main characteristics are presented in the table 1. The EHV cable is sheathed with a standard black HDPE (no flame retardant properties). MV1 is sheathed with black LLDPE (no flame retardent properties). The other MV cables have flame retardant jackets. MV2 is sheathed with Si-gum, $CaCO_3$ filled LDPE. The jackets of MV3 and MV4 are based on hydrate filled LSZH (Low Smoke Zero Halogen) technology, according to the respective manufacturers´recipe.