Development of a up to 400kV XLPE Cable with Low-Smoke Properties to be Installed in a Tunnel

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Recent experience shows that more and more high (HV) and extra high voltage (EHV) cables are installed either in tunnels or in sensitive areas where flame and smoke performance may become an issue should the cable be impacted by a fire during its operational lifetime. During a fire these cables will normally be switched off. However, they should not contribute to the fuel load in the event of an external fire. If they are involved in a fire they should act in a neutral manner and not contribute hazardous gases and energy to it.

The move from self-contained fluid filled cables to solid dielectrics has already reduced the fire risks of HV and EHV power transmission within tunnels. Nevertheless the materials (insulation and jacket) used in an extruded cables are still to some extent flammable. The traditional use of poly vinyl chloride (PVC) as a fire performance jacketing is becoming less practical for several reason such as creation of dense obscuring black smoke and the liberation of toxic products that are deleterious to humans and machinery. This is in addition to the well-known limitations of PVC in terms of water transmission and sensitivity to abrasion and impact.

After our first development of a 500kV cable system we have tested several solutions to the complex problem of providing both fire and mechanical protection of cables. These performances were compared with our desire to achieve a cable with low-smoke properties that could be installed in both tunnels and also directly in the ground. Investigations were made to check not only the obvious influence of different sheathing materials, but also the inherent blend to blend variations in the jacket materials. The tests were carried out according to IEC 61034. Reflect upon some of the deficiencies observed in the practices advocated within the standard. These will include correction factor for the smoke density for big cables, augmentation to address larger cables rather the more common small diameter cables.

It proved very beneficial to make use of IEC 60332-3 to check the fire propagation of these cables. This was not immediately apparent as this standard designed for the installation cable and not for HV and EHV cables. It is interesting to note that since there was no widely accepted international standard available it is quite common to find this approach used by utilities and customers.

In this paper we will:

1. Describe the test procedure
2. Analyse the results on a number of cable system designs
3. Provide input on
    1. difference between various metal sheaths
    2. different materials
    3. lot to lot variation of the same material
4. Describe the issues of water absorption of these sheathing materials in the direct buried application

If accepted the authors would like to have oral presentation in section 8 or 4