

Ampacity calculation of multiple independent cable systems in ventilated tunnels

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In 2017, the International Electrotechnical Commission (IEC) published the new standard IEC 60287-2-3 for the calculation of the current rating of cables installed in ventilated tunnels. The main features of the calculation method are based on the report of a CIGRE working group published in Electra n°143 and 144. The IEC method is fast and easy to use but limited to the calculation of identical cable system. The method is not suited for applications with multiple independent cable circuits.

The air flow in the tunnel removes heat from the cables and transports it along the tunnel axis, thus gradually increasing the air temperature. Therefore, calculating the rating for cables in ventilated tunnels must consider longitudinal temperature gradients for which a general simplified iterative method is provided.

The numerical method consists of a thermal network representing slices of the tunnel cross sections. One slice is axially connected with the next by the longitudinal heat transfer of the air flow along the tunnel. For every slice, a delta-star transformation is applied in order to derive a thermal network with only one thermal resistance each between the star point and the cable surface, respectively tunnel wall. This allows the definition of a fictitious increase of the ambient temperature to account for the ventilation. The equivalent thermal resistance of the cable surrounding is used similar to the classical formula in order to determine the permissible current rating.

Only one commercially available software tool was found capable to compute the cable rating for cables in ventilated tunnels, but with the limitation that only one cable system can be used. The planning of a new 1.2 km long energy tunnel with 400 kV cables at the Swissgrid substation Bâtiaz needed to consider two different systems. Based on previous work by Dr. J. Pilgrim et. al. a new method was developed to allow for the calculation of multiple different cable systems or other heat sources in ventilated tunnels. The method was fully integrated into the existing framework of the web-based cable calculation tool Cableizer.

The calculation report contains for each system a plot with the distribution of temperatures along the tunnel.

Key words

Ampacity, Cable Rating, Cables in Tunnel

Topic (Category)

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