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Simplified expressions for the evaluation of the cyclic ratings of low voltage and medium voltage cables in non sinusoidal conditions

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The presence of current and voltage harmonics in distribution energy systems is well known; the harmonics are due to single phase ad three phase non linear loads and can damage the electric system components. In the case of the cables, current and voltage harmonics can cause so relevant additional losses in the conducting and in the insulating materials that not acceptable cable life reduction arises if they are neglected in the cable thermal sizing.

The low voltage and medium voltage cable rating in non sinusoidal steady-state operating conditions has been analysed in literature [1-4]. All the procedures start from a thermal lumped parameter network to drawn simplified relations for the cable rating evaluation; they refer to steady-state non sinusoidal currents (100% load factor).

As well known, the medium voltage or low voltage cables can be subjected to cyclic loads which require a different calculation of ratings.

In sinusoidal conditions this problem was analysed firstly in [5]; a simplified approach is proposed based on the use of the 100% load factor steady-state rating equations in which the daily cycle is taken into account by introducing a modification to the external thermal resistance of the cable. Another simplified approach was proposed in [6] and later adopted by the IEC Standard [7]; this approach requires computation of a cyclic rating factor by which the 100% load factor steady-state rating equations may be multiplied to obtain the permissible peak value of current during a daily cycle.

In this paper, the simplified procedure adopted by IEC Standard [7] is extended to the case in which the cyclic load current is non sinusoidal as a consequence of the presence of non linear loads; particular attention is paid to consider typical non linear loads in order to furnish indication regarding the derating factors to be introduced as a consequence of their presence. The influence of partial drying of the surrounding soil is also taken into account. Numerical applications to some standard cross-sections are developed and discussed in order to show the cable cyclic current ratings in non sinusoidal steady state conditions.

References

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