STATISTICAL FEEDBACK APPROACH IN CYCLIC RATING FACTOR SIZING

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ABSTRACT

Cycling rating factor is one of significant parameters in underground cable design. Theoretical values are used in design, mainly depending on the voltage level of the line.

The study aims to compare these theoretical values to the real values of the network, using a statistical approach.

The comparison can lead to confirm the actual theoretical values and/or a necessary adjustment in order to improve cable design on the network.

KEYWORDS

Rating Factor, cables, steady - state rated current, load cycle

INTRODUCTION

Due to an increasing load demand, it is essential for the network operator to be able to regulate the power rating close to the limits, with the confidence in never exceeding them, in nominal or contingency conditions. The assessment of permissible current rating becomes of high value.

A cable system is often designed according to the "steady-state" operation criterion (100% load factor of IEC 60287-1-1). This design, with a continuous constant current producing asymptotically the maximum conductor temperature, is on the safe side and can be optimised, taking into account periodic load variations. Due to thermal inertia, a cable system can withstand a peak value I_{max} greater than the permissible steady-state rated current I_R without exceeding the standard maximum temperature during a daily cycle. IEC 60853-2 defines the cyclic rating factor $M = I_{max}/I_R$ and provides the process for its computation. RTE, the French Transmission System Operator, relies on an "*F* factor" (as the rate between the measured average current rating and the peak current value during a cycle), which can be used in the same way as 1/*M* in order to assess the ability of a cable system to vary around a reference rating value for a factual load cycle.

RTE has developed user-friendly and competitive tools to analyse the huge amount of collected data of transmitted power (more than 6,000 circuits are listed, overhead, underground and mixed with siphons). Charts of *F* factor from daily to yearly cycles can be displayed for one or a set of transmission lines, for a geographic area or for the whole grid.

The good assessment of the actual cyclic rating factor may allow to uprate an existing cable system and helps in designing the new lines with more accuracy and confidence.

This study carried out to evaluate the relevance of the present theoretical cyclic current rating values used by the engineering department to design the cable systems. Using statistical results from specific classes of transmission lines, some interesting pooling with a common behaviour and recommendations can be found. This analysis is applied for the entire French network, within one year, leading to the highlight of several criteria involving interesting connections. In order to suggest relevant statistical trends, processing of mean, uneven and highest values are done.

1. THE AVERAGE OF THE "F FACTOR" (1/CYCLIC RATING FACTOR)

The next figure shows the average of the daily, monthly and yearly values of the "F Factor" registered in 2010 on 1130 underground cables and mixed lines of the 63 kV French networks.

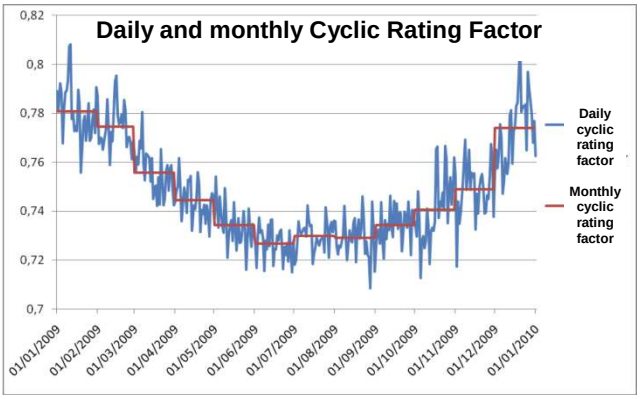

Figure1: Impact of the daily and monthly "F Factor"

Some filtering criteria have been applied in order to detect the general tendencies having an "F Factor" lower than the actual theoretical value, established today at 0.9.

We can see that the "F Factor" curve presents some irregularities; its amplitude turns around 0.02 value. All the daily's values are between [0.7; 0.82], less than the actual theoretical value of 0.9. The highest values of the "F Factor" are registered in winter, between the months of December and February (the average is around 0.78). The lowest value is seen in the summer months, from March to November (the average is around 0.74 value).