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D.2.12. Prévision et capacité de transport probabiliste des câbles souterrains d'énergie

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D.2.12. Forecasting & probabilistic rating of underground power cables

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This paper reports on a study funded by The National Grid Company into the use of a probabilistic method for cable rating.

Cable ratings have been calculated based on constant, worst-case parameter values using off-line calculation methods as outlined in Electra No 87 and recommended in the IEC standards 287 and 853-2. However, the thermal parameters influencing the cable rating; ambient temperature, and soil moisture content and thermal resistivity, are rarely constant and are subject to random variations.

These traditional rating methods are conservative and a 'reserve' current carrying capacity exists within the cables, which can be realised by using on-line or probabilistic rating methods.

NGC have developed an online Cable System Monitor (CSM) that provides on-line continuous and overload thermal ratings of most of their underground cable circuits, both 275 and 400 kV. These ratings are based on system measurement and real-time modelling of the cable systems, adapted from off-line rating software based on the method described in Electra No 87. However no provision is made for forecasting realistic ratings, further than a few days in advance, such as may be required planning circuit outages. A probabilistic method as described in this paper provides this facility.

The probabilistic model presented relies on the probabilities which are associated with the value of each variable parameter. These, in association with a linear piecewise approximation, the Monte Carlo simulation method, and a sensitivity technique, have enabled a probability distribution to be produced of the possible ratings for a specific cable circuit during a specific time period. Ratings can then be selected with a predetermined risk of exceeding the cable operating temperature limit.

By considering the probability distributions of the thermal parameters of the circuit, and the 24 hour cyclic pre-load variations, in previous years, forecasts are presented for the same date in the future. Results are presented for a specific cable circuit based on a specific 24 hour period, using data collected over several years, including comparisons between forecasts and actual ratings calculated by the CSM at the forecast time.